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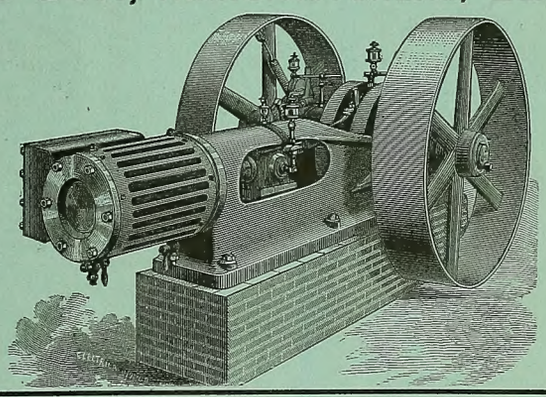

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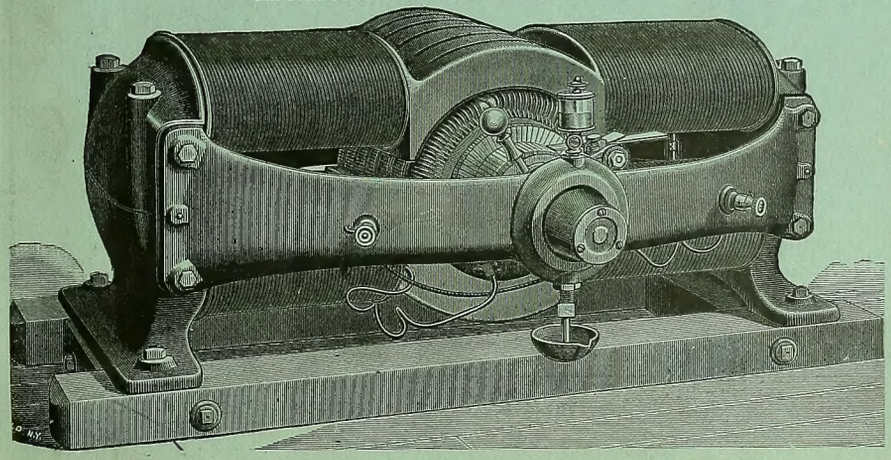

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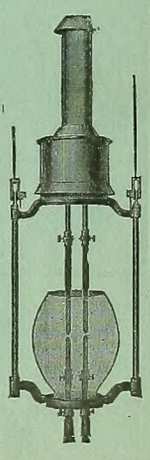

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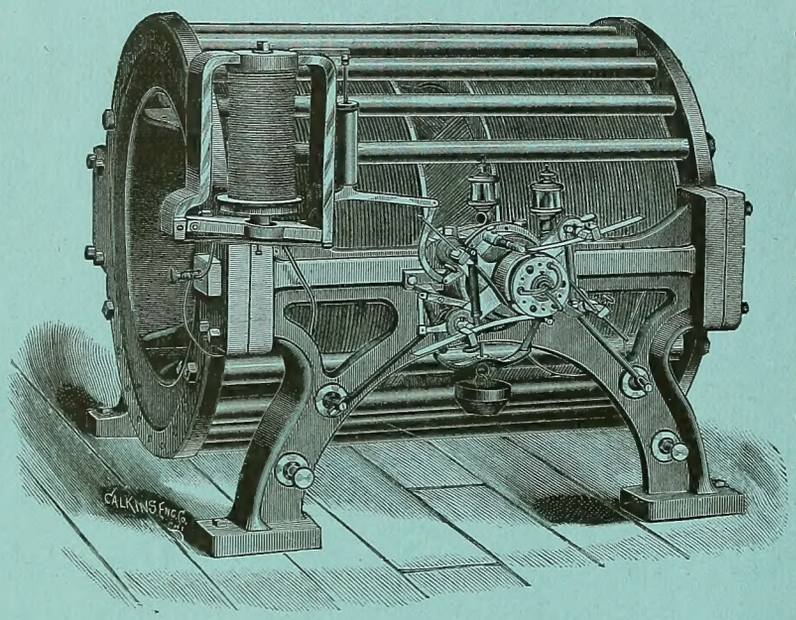

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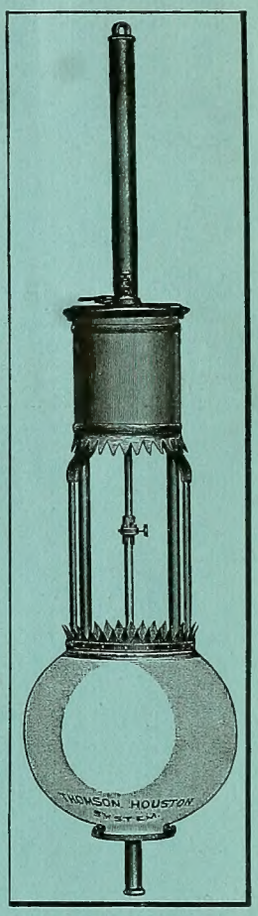

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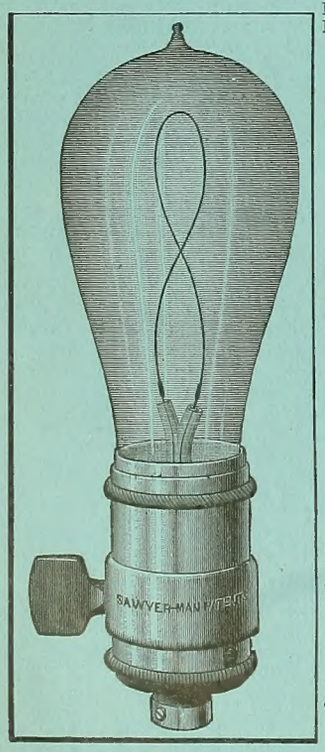

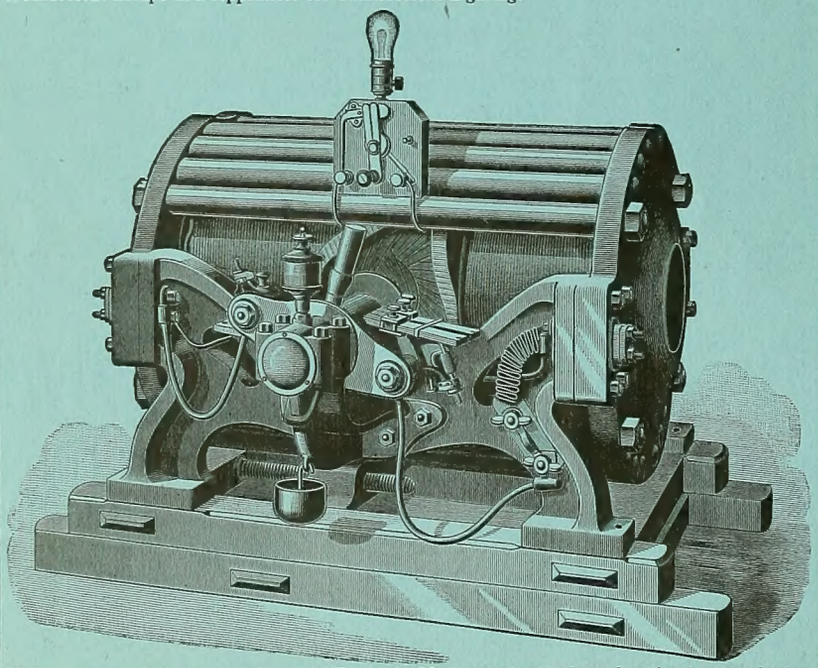

This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

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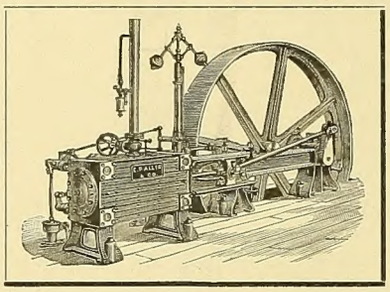

We refer to the following electric light plants now using the Reynolds' Corliss:
Brush Electric Light and Power Co., Cleveland, O.
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Louisiana Electric Light and Power Co., New Orleans, La., three engines.
Badger Illuminating Co., Milwaukee, Wis., two engines.
West Side Power Co., Minneapolis, Minn., four engines.
Louisville Electric Light Co., Louisville, Ky.
La Crosse Brush Electric Light and Power Co., La Crosse, Wis.
C., M. & St. P. R. R., Milwaukee, Wis.
Menominee Mining Co., Iron Mountain, Mich.
West Hotel, Minneapolis, Minn.
Plankinton House, Milwaukee, Wis.
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Chas. H. Slack, Chicago, Ill.
Mandel Brothers, Chicago, Ill.
C. Boetcher, Leadville, Col.
Omaha Thomson-Houston Electric Light Co., Omaha, Neb.
Thomson-Houston Electric Co., Racine, Wis.
Sioux Falls Electric Light and Power Co., Sioux Falls, Dakota.
Electric and Water Supply Co., Nellsville, Wis.

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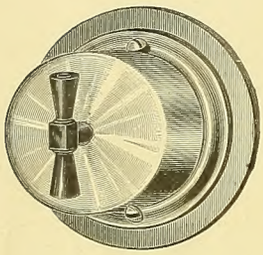

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Quick Make and Break Uncontrolled by the Handle.

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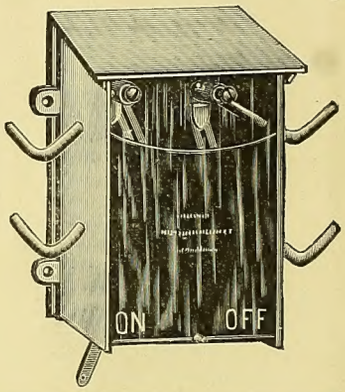

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GILES ANTI-MAGNETIC SHIELD FOR WATCHES.

Office of Van Depoele Electric M'fg. Co.
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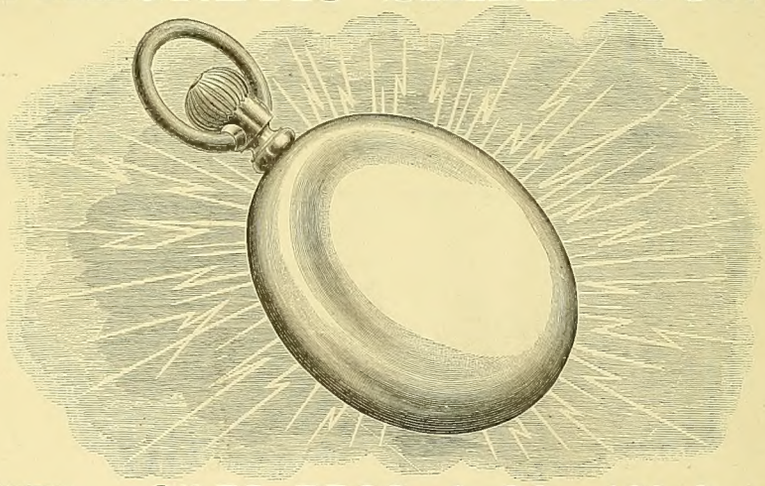
Anti-Magnetic Shield & Watch Case Co.

Gentlemen :—Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good time-keeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is.

Very Respectfully,
CHAS. J. VAN DEPOELE,
Electrician, V. D. P. E. M. Co.



"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

WM. A. ANTHONY,
Prof. Phs. Dept., Cornell University.

The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers; it will render operative the fine adjustments and mechanisms which hitherto have been made almost *nil* and inoperative on account of their susceptibility to the all-pervading magnetic influence. AMERICAN WATCH CO.,
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Sure protection from all Electrical and Magnetic disturbances. Send for descriptive circular.

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AUTOMATIC

Cut-Off Engines,

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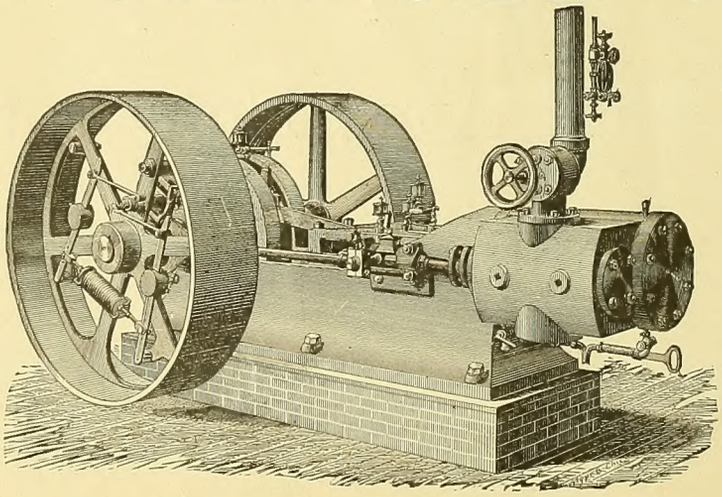
And other duty requiring close regulation of speed.



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Small space required.
Simplicity of construction.
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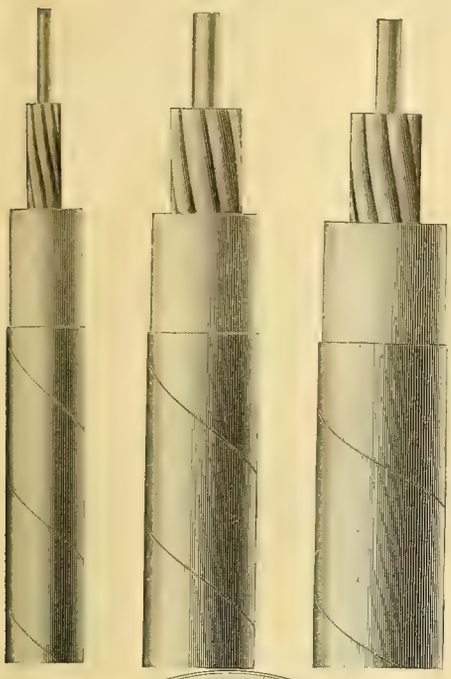

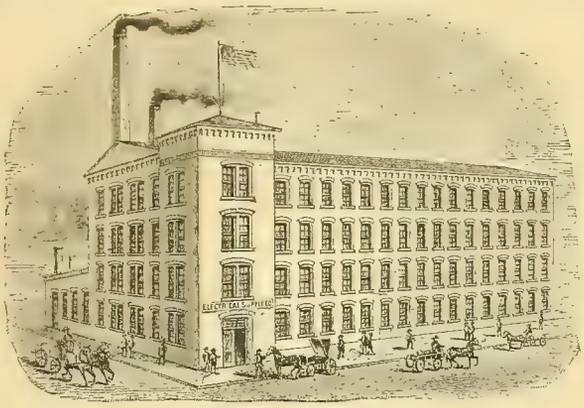

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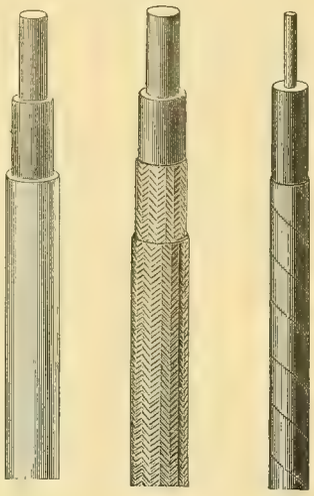

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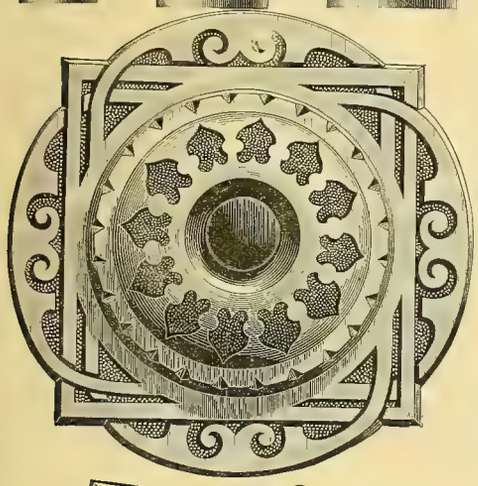

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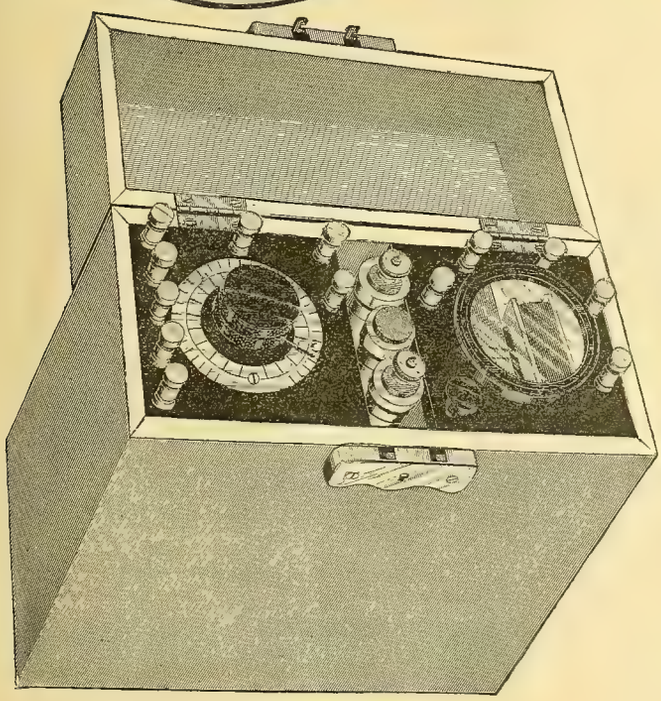

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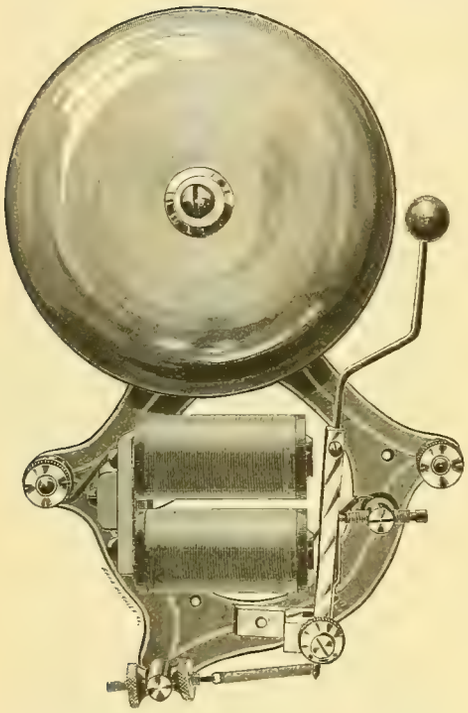

THE

BEST

AT

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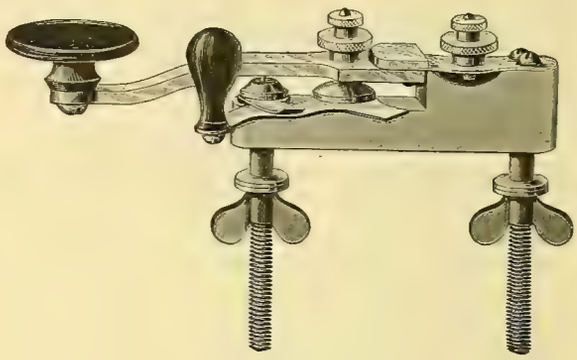
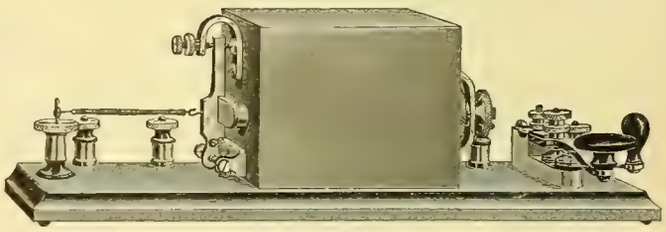
PRICES.





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WESTERN ELECTRIC COMPANY,

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Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, JULY 2, 1887. No. 1.

Telephone System for Large Buildings.

In many public and other large buildings, such as state houses, city halls, court houses, asylums, manufactories, wholesale stores, and hotels, a telephone system whereby departments, rooms or floors, can be connected one with another, without having to call upon a third party to make the connection, is often very desirable; not only desirable, but very important and necessary. The Western Electric company of Chicago, are furnishing such a system. Their factory on Clinton street, is equipped with an outfit of six stations. The city hall in Chicago, has an outfit of twelve stations. These two places have used the system for over a year and a half. The offices of the Union Pacific railway company at Omaha, were fitted up last fall with sixteen stations, and recently they have ordered another outfit of eleven stations.

Almost any number of stations can be provided for. It is not necessary to fully equip a building at first; two or more stations can be put in, and others added as they are needed. It is necessary, however, to know how many stations will ultimately be wanted in any one building, so that the growth may be provided for in the construction of the apparatus.

The accompanying diagram (Fig. 1) illustrates the system. A cable containing as many wires as will ever be needed, is run through all the rooms of the building that are to be connected, and each station outfit is connected to the main cable by a branch cable. There are two more wires in this cable than the number of station outfits when the equipment is complete; one of which is the battery or calling wire, and the other is the common return wire. Each station outfit (Fig. 2) consists of a vibrating call bell, a number of plug sockets with calling springs attached, a battery box, and the telephone and transmitter. A cord and plug hang at the right side for connecting the telephone to either of the other telephones by means of the sockets mentioned.

"To use the system," quoting the directions of the manufacturers to users, "if your own bell rings, all you have to do is to take the telephone from the hook and answer the call. If you want to call another party, you take the plug that hangs at the right-hand side and insert it in the socket of the number you want, and then push the spring of the same socket, which will ring the bell of the party wanted. Before pressing the spring, however, it will be well for you to listen in your telephone to learn whether that party is using his telephone or not. If he is not, you will hear the vibrations of his bell caused by the breaking of the battery circuit by his bell. If you do not hear this vibratory sound, or if you hear him talking, you will know that his line is busy and that you must keep out a little while. When you are through talking, pull out the plug and hang up your telephone."

The system is so arranged that all the telephones can be in use at the same time. For instance, if there are twelve stations and 1 and 7 are talking together, 2 and 8, 3 and 9, 4 and 10, 5 and 11, 6 and 12, or any other combination can be made, and all the couples can carry on their respective conversations at the same time. Sometimes two persons may be talking and may want to consult a third who is in some other part of the building. They can call him up and the three can talk together.

This system can be connected to the city exchange if there is one of its instruments in the building, so that either of the rooms could be connected with one of the city subscribers, or a city subscriber could call and talk to one of the telephones in the building.

The diagram (Fig. 1) represents an outfit consisting of ten stations. A, A and A., are three station outfits. B is a diagram of the circuits of one of the stations. C is a twelve-wire cable, ten of the wires being line wires, one the battery wire, and the other the common return or ground wire. D is the calling battery. There is one bell or telephone outfit connected to each line, the other end of the line remaining open, as an examination of the diagram will show. When a plug is inserted in one of the sockets, a metallic circuit is established taking in the two telephones. Pressing any one of the calling springs rings the bell connected to the line bearing the same number as the spring pressed, whether the plug is inserted in the socket or not.

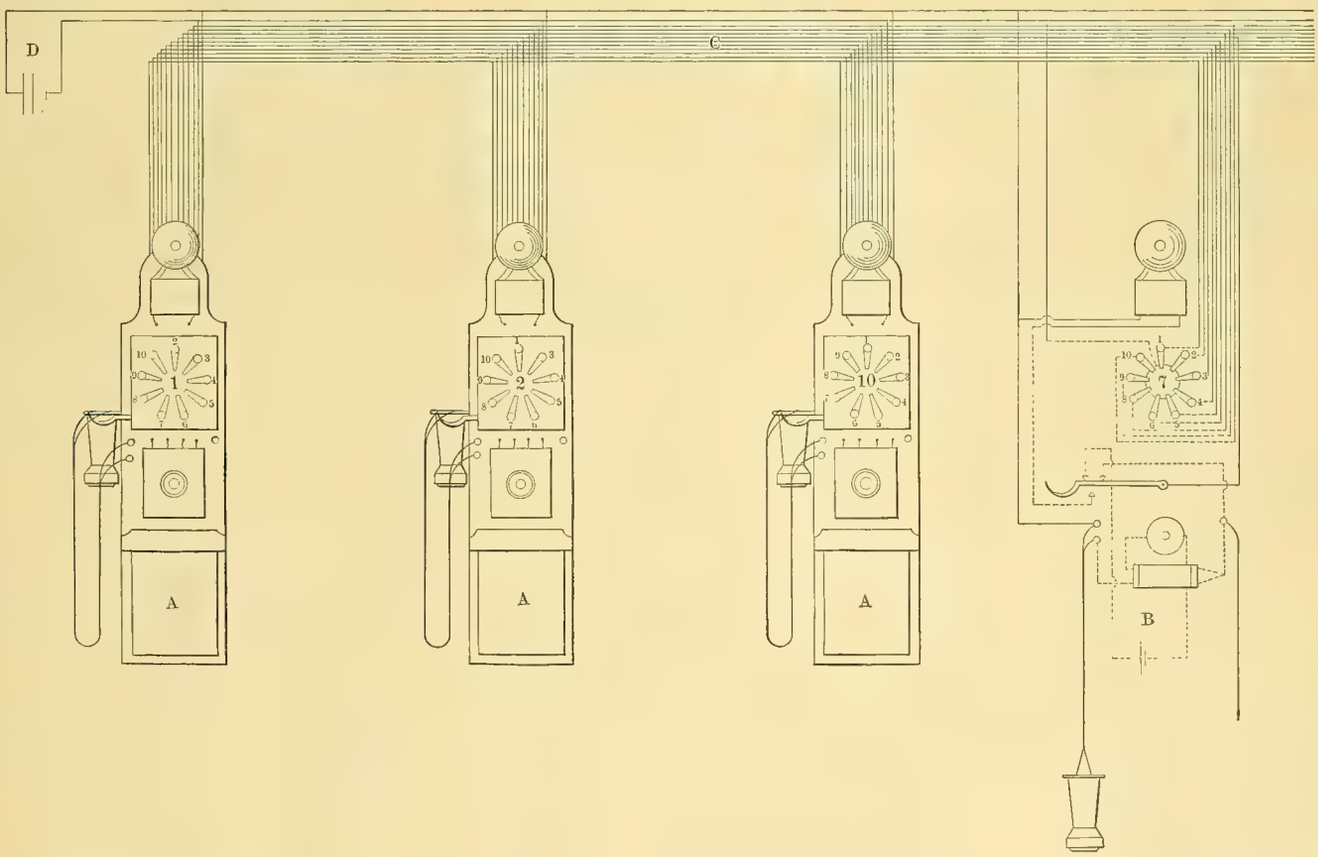


Fig. 1.—Telephone System for Large Buildings.

Professor Barrett's Plan Adopted.

The plan of Professor Barrett, city electrician of Chicago, of connecting the bridges by telephones and described in an interview on the second page of this number, was adopted in part at any rate, at a meeting of the city council Monday evening, June 27th. The details will be given hereafter.

A Remedy for the Bridge Nuisance.

Early last month Mayor Roche of Chicago sent a communication to the city council referring to the "bridge nuisance" and suggesting that main bridges be opened from 12 o'clock midnight until six o'clock in the morning during the season of navigation, and that four bridges at Clark, Madison, Adams and Twelfth streets be closed at intervals of an hour for three or five minutes, if necessary, for the crossing of street cars, vehicles and pedestrians. With the communication was submitted an estimate by Prof. J. P. Barrett, city electrician, for lighting the bridges and viaducts of the river by electricity. The electrician proposed to establish the plant in the pumping house at the foot of Washington street, using an engine and boiler of 125 horse power, four thirty-light dynamos and 100 double carbon arc lamps. He would use ten miles of number 5 armored cable and would drop it into the river from the line of docks on both sides with loops running to bridge approaches on both sides of the river, the cable coming up on each side of the approaches, to be protected in iron pipes. The cost was figured as follows: Dynamos and lamps, $9,350; engine and boiler, with pumps, heater, steam connection and foundation, $4,000; cable, ready for attachment to dynamos, including labor, estimating on a distance of ten miles, $26,400; new building for the plant, including a smoke stack, $8,000,—a total of $47,750, with everything ready for operation. The cost of operation, with six per cent. added for interest on the investment, was figured at $101.65 per lamp per night every night in the year, which was stated to be about 43 per cent. less for all-night lighting than any city in the country.

Of course, the vessel men have taken strong exception to a plan that would deprive them of the run of the river practically three-fourths of each day, and have held meetings and written letters vehemently denouncing the proposition of the mayor. They call attention to the vast extent of the vessel trade and declare that if the proposition is carried into effect it will drive commerce to other ports. The mayor replies that in sea port cities where vessels have to await the time of the tides, where natural laws limit the hours of arrival and departure of vessels, there is no complaint on the part of vessel owners, but hours for arrival and departure are timed in accordance with those natural laws, and he argues that the arrival and departure of vessels at the port of Chicago could be timed to meet the requirements of city laws. He meets the point of the magnitude of the vessel interests by saying that there are at least seven hundred thousand people in Chicago who are not interested in lake commerce but who are interested in the bridge nuisance. The whole matter is in the hands of a committee under consideration.

In a chat with a WESTERN ELECTRICIAN representative, Prof. Barrett suggested a remedy which, while very simple, will go far toward mitigating the bridge nuisance. "Let the harbormaster," he said, "act in conjunction with the bridge tenders. Let him hold a position analogous to that of a train dispatcher on a railroad, and connect him by telephone to each of the bridges. Say there are a dozen vessels in the harbor that wish to tie up at different docks along the main channel and the north and south channels. The harbor master arranges the vessels in line, and all those that wish to go up the south channel follow each other in rapid succession; likewise those bound up the north channel or for docks along the main channel.

"When vessels wish to move down the river the nearest bridge tender is notified of the destination, whether to another dock or whether to the harbor. It may be that two or three vessels in the south branch are all ready for the clear run of the river and that on the north branch there are as many vessels likewise wishing the clear run of the river. The different bridge tenders notify the harbor master, and when all are ready he gives orders for those on the south and north branches to move simultaneously, timing their movements so as to move down the main channel together, thus avoiding the necessity of opening each bridge maybe a half dozen different times for a half dozen individual vessels."

As stated, this plan is a simple one. It has the merit of being comparatively inexpensive, both in the installment of the telephones and the maintenance of the system. It is not designed to change the existing ordinances in regard to vessels passing either way on the river, but only to reduce the existing circumstances to a system which will to a degree lessen the nuisance of bridges, outside of the hours they are now closed by ordinance, being swung at the bidding and sweet will of every captain.

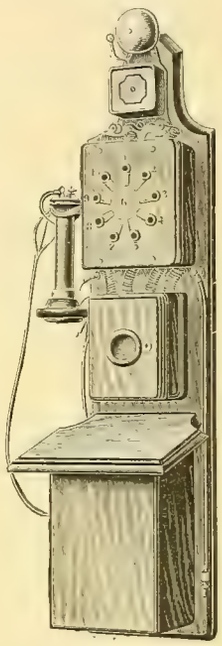
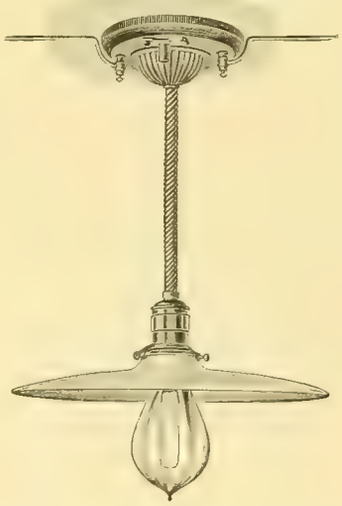


FIG. 2.—TELEPHONE SYSTEM FOR LARGE BUILDINGS.

New Series Incandescent Lamp.

The cut shown herewith shows the style of the new series lamps of the Thomson-Houston Electric Company. These lamps have been in use about six months and have given both the users and the company such satisfaction that special efforts to bring them before the public are warranted.

The company claim for the light great steadiness, and as a glance at the illustration shows the



light is not dissipated upon the ceiling or upper part of the room but is thoroughly diffused and, of course, is disposed where it is most needed.

These lamps can be used in arc light circuits and are provided with a switch and cut-out, the same as an arc light. The lamps are made 32, 65 and 125 candle-power for 1,200 candle-power current, and 65 and 125 candle-power for the 2,000 candle-power current. It is claimed that the amount of effective light secured from one of the 65 candle-power series lamp is more than four times that given by one of the ordinary 16 candle-power lights of other systems, and it follows that the expense of installation is very much less. The equipment of each light consists of a neat brass pendant, or chandelier, connected to a ceiling board, shade, shade holder, automatic cut-out, and the whole is ready to be put into immediate use upon receipt. These lamps, in connection with the direct system of incandescence of this company, are especially recommended for halls, small stores, public buildings, churches, chapels, and for most commercial purposes where a brilliant and steady light is required and where it is not economical to install the arc light. A strong claim for the light is made in that the series incandescent is the only system of incandescent lighting which furnishes over 200 candle-power per horse power. The lamps can be used at great distances from the central station, are attractive in appearance, are economical, are simple and are bound to add much, as their use becomes more general, to the popularity they now enjoy.

Prof. Gray's Telautograph.

Prof. Elisha Gray of Chicago has recently invented an instrument under the above name, and filed applications for patent in the United States and various European countries. The instrument, as its name imports, writes automatically at a distance by means of an electric current so as to reproduce a fac-simile of what the writer wishes to transmit, as a message, note, draft, or other written document, with such perfect accuracy that the writing and signature can be accepted as evidence in a court of justice. "Here," said the professor in the course of a brief interview, "is the word 'Chicago,' reproduced by this process on this scrap of paper, which any one familiar with my writing can recognize at once." As each line is finished the writer touches a button and the paper is moved up the proper distance for the next line as in the typewriter, and all the movements of pen and paper are reproduced automatically at the distant station.

The instrument is intended chiefly for local work, having about the same range as the telephone, so that messages can be transmitted to different parts of a city, and to out-lying stations within a radius of about 100 miles. Professor Gray thinks the device can be adopted to the duplex method of transmission but not to the quadruplex. The chief feature of the device is the plate or instrument on which the writing is done. No particular kind of pen or pencil is required, any sharp-pointed instrument answering the purpose; neither does the paper on which the writing is done, or on which it is reproduced, require any special preparation. It is the pressure on the plate which gives the electric impulse, and moves the tracing point by which the writing is reproduced; and this tracing point may be an inked pen or a lead pencil, which is attached to a movable arm in the receiving instrument at the other end of the line.

A Cable in a Creosoted Box.

The Chicago Telephone Company is laying a cable in Madison street from Halsted street to Ashland avenue, a distance of about a mile, but the equivalent in single wire is about 250 miles. In laying cables heretofore, the company has placed them in wooden boxes and filled in concrete or some similar material to protect them from mechanical injury. The Madison street cable is being laid in a creosoted wooden box just large enough to hold the cable, and no filling of any kind is put in. The top of the box is sheeted with quarter-inch iron which will resist the blow of a pick in the hands of a laborer, who is unwittingly the source of the greatest injury to underground cables.

On the south side the company is putting down a conduit in Calhoun place from LaSalle street around to the corner of Franklin and Washington streets, where the new building of the company is to be located. The conduit will be made up of sixteen two and one-half inch wrought iron pipes and each pipe will contain a 200-wire cable. The pipes will be laid in the trench, boards put on either side to form a mold for the filling, and concrete will be poured in, making a solid bed of pipes and concrete about two feet deep by two feet wide.

Boston has an electric club, recently started.

The Elements of Electric Lighting.

NUMBER 1.

The requisites for the production of the electric light are an electric generator, an electric lamp, and a conductor connecting the generator and lamp.

The generator must be capable of producing continuous, steady electric action of sufficient energy for the required work. It may be either an ordinary battery, or a dynamo.

From the beginning of the present century until about 1867 the battery was the only known generator capable of producing the electric light; the electric machine, though capable of powerful effects, being incapable of producing a continuous electric current. All batteries are not equally well adapted to this purpose; the Daniell, Leclanché, and many others, which are adapted to various other kinds of electric work, are not suitable for the production of the electric light. The Bunsen battery can be used, and if a light of short duration only is required, as in surgical examinations or theatrical effects, any good carbon-zinc battery will answer the purpose But for a strong light of several hours duration the Grove battery is superior to all others, 40 to 50 Grove cells being capable of producing such a light for two or three hours. From these facts it is easy to see why electric lighting, though known as early as 1800, was merely a laboratory experiment until about 1867, the great expense and labor of renewing the fluid in 40 or 50 Grove cells once in two or three hours being alone sufficient to render the ordinary use of the light obtained in this way impracticable, while the noxious fumes from such a battery make its use for this purpose equally impracticable.

THE DYNAMO.

In 1867 the previous inventions of several leading electricians culminated in the production of the dynamo, and the problem of general electric lighting on an economical basis received a practical solution, since electricity could now be generated by mechanical power at far less cost and in far greater quantity than was possible or practicable by the chemical process of the battery.

Without entering into perplexing details, the essential parts of the dynamo, and its mode of action, may be briefly described. Those parts are the armature, the field magnets, the commutator and the brushes.

THE ARMATURE.—The armature, in its usual form, consists of a number of coils of copper wire, wound on an iron ring, which is mounted on an axis and revolved between the poles of the field magnets, as shown in Fig. 1. The iron ring or

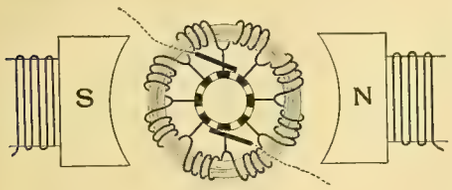


Fig. 1.

core of the armature may consist of a number of iron wire rings, or of flat rings stamped out of thin sheet iron and placed vertically side by side, or of thin iron hoops laid over each other. These should be of the best soft iron and electrically insulated from each other by varnish, asbestos, mica or other suitable insulator. Solid iron cores are objectionable, chiefly on account of becoming heated, and the cores here described are greatly improved by having an open structure, so far as practicable, for the free circulation of air, by which the heating is greatly reduced. The insulation and composite structure, described above, are also important in giving the electric current its proper normal direction and preventing the formation of electric eddies which waste the energy and generate heat, a fault to which solid cores are especially liable.

The coils shown in the figures are reduced to a few turns of wire and an open structure, but those in actual use consist of a number of layers, closely wound like thread on a spool. The wire should be as large and the number of turns in each coil as numerous as practical convenience will admit, the resistance of the wire to the passage of the electric current, and the consequent heating being reduced with increase of size, while the electric energy increases with the number of turns; each turn adding its quota to the current generated. The wire in the coils, and in every part of the dynamo and its connections through which an electric current flows, must be covered with some good insulating material, which will confine the current to the direction in which it is designed to flow, and prevent its escape from one turn to another, or to any object with which the wire may come in contact.

THE COMMUTATOR—Figs. 1 and 2 show that the ends of the coils connect with cylindric segments at the axis of the armature: these constitute the commutator or collector whose use will be fully explained hereafter. Its segments are of copper or some other suitable metal, as phosphor-bronze, or gun-metal; the requisites being that the metal must be a good conductor, and not liable to heating or corrosion. They are attached to the axis, and insulated from it and

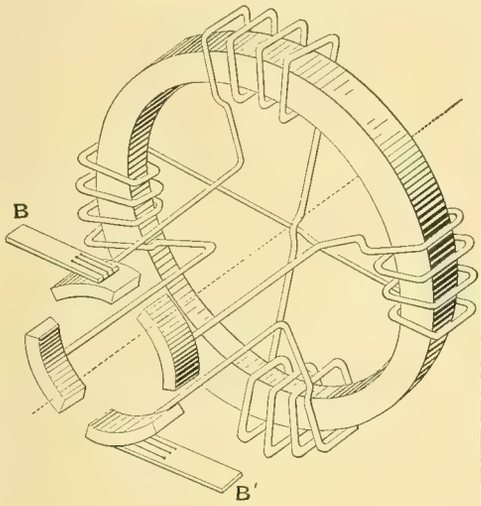


FIG. 2.

from each other, and of the same number as the coils; and special provisions are required to prevent the spaces between segments from becoming clogged with conducting material as copper dust, or carbonized oil, by which the insulation is reduced or suspended.

CLOSED CIRCUIT AND OPEN CIRCUIT ARMATURES.—In some armatures the coils connect with each other all around in a closed circuit, while each one connects also with a separate segment of the commutator, as shown in Fig. 1. In others they are arranged in pairs on opposite sides of the ring, each pair being connected with opposite segments of the commutator, and independent of all others as shown in Fig. 2. The first kind are known as closed circuit armatures, as in the Gramme dynamo, the second kind as open circuit armatures as in the Brush dynamo.

THE BRUSHES.—The brushes by which the electric current is taken up and transferred through conductors to the lamp are shown in Fig. 2, in their usual position in contact with the commutator. They are made of copper, and are of different styles as shown in Fig. 3, which shows the under brushes as viewed from above; the style at A consisting of two layers of wires soldered together at the upper end; the one at B of two broad strips divided as shown for a certain distance from the lower end; the one at C, of several undivided strips of different lengths, overlapping each other. Sometimes two of these styles, as A and B or A and C, are combined in the same brush. The main object is to obtain the best contact at numerous points, and to prevent the waste of energy and irregularity caused by sparking at the points of contact. The brushes are held in suitable clamps in the position shown in Figs. 1 and 2, their free ends pointing in the direction in which the armature revolves; and a steady pressure is maintained by their elasticity.

THE FIELD MAGNETS.—In Fig. 1 we have an ideal representation of the field magnets on each side of the armature, with their pole pieces partly inclosing it. They may be permanent steel magnets or electromagnets. Permanent magnets are suitable only for small hand dynamos, designed for experimental laboratory work. For this purpose the permanent magnetism is an advantage, since there can be no such increase of force as to prevent the operation of the dynamo by hand, which might be the case with electro-magnets. But the low energy of permanent magnets as compared with electro-magnets, and their liability to partial loss of magnetism with age renders them unsuitable for dynamos of the energy required for the electric light.

The term electro-magnet is used to designate any magnet having an iron core wound with insulated wire, through which an electric current may be transmitted; the armature itself is such a magnet. The core becomes magnetic only while the current is flowing through the wire; and its magnetism ceases with the cessation of the current, leaving only a slight trace known as residual magnetism, which in dynamos has an important function, as will be explained hereafter.

The ends of every magnet are technically termed poles, distinguished respectively as north and south, by the direction in which a straight bar magnet points when freely suspended, and marked N and S. In the dynamo, north and south poles face each other, and into the space between them, in which the armature revolves, lines of magnetic force radiate, constituting what is technically termed the magnetic field; hence the magnets are called field magnets. They may be straight magnets, as shown in Fig. 1, a single north pole facing a single south pole, or horseshoe magnets, two north poles facing two south poles. The core should be of the best soft iron, either wrought or cast, wrought being preferred. The pole-pieces, which are considerably wider than the core, are curved, inclosing a large portion of the armature and confining all the lines of force, and are placed as close to the armature as safety of rotation will admit, so as to reduce the magnetic resistance to its minimum, as the lines of force traverse the field; the resistance of the air being immensely greater than that of the iron core of the armature.

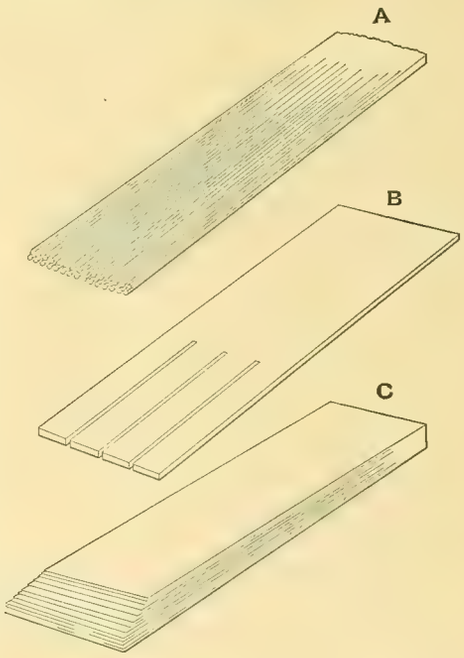


FIG. 3.

Cast iron is often used for pole-pieces, but wrought iron seems to have the preference; and a laminated structure, composed of numerous thin layers combined, is also recommended; the object being, as in the armature core, to give the lines of force their proper direction.

Large wire, well insulated, is as essential for the winding of the field magnets as for that of the armature, for the reasons already given; and a greater body of wire in the central portion of the magnet than near the ends is recommended, as giving a more even current, less subject to sudden fluctuation, which, in an electric light dynamo, is a very essential point.

June 21st the house fund of the American Institute of Electrical Engineers had increased to $4,415.

Millimetrical Measurement of Wire.

By F. R. Welles.

The adoption of metric measurement for wires and sheet metals may be desirable, but it is doubtful if the gauge suggested to the National Electric Light association will prove to be the right thing. That gauge is open to the objection that it reverses the accustomed order of progress from large to small sizes, and will thus be confusing to the mind, at least in its introduction. Then the differences between the successive numbers are too small in the large sizes, and too large in the small sizes. For instance, No. 1 would be 10-100 of a millimetre, or 4 mils; No. 2 would be 20-100 (8 mils), and No. 3, 30-100 (12 mils). The jump from 10 to 20-hundredths (4 to 8 mils), and from 20 to 30 (8 to 12 mils), is much too great. For these three numbers of the proposed gauge there are 10 numbers of the B. & S. gauge, and they are all needed. The proposed gauge, therefore, could not be used for these small sizes, which must be designated by the numbers of some other gauge, or else by decimals of an inch or of a millimetre. In the large sizes, on the other hand, there is no need for so many numbers. From 4 to 6 mm., for instance, the gauge offers 20 numbers, against four in the B. & S. gauge. From 6 to 8 mm. there are 20 numbers again, to only 3 of the B. & S. gauge, which may, perhaps, have too few numbers in these large sizes, for some purposes; but so great an increase is certainly needless.

If we must have a gauge of some sort, it would seem that its principle of construction should be that of increasing differences between the successive sizes, in passing from small to large. A mere arithmetical progression leads to the defects noted above, and the making of a gauge without any apparent guiding principle at all leads to the anomalies observed in the Birmingham, Old English, Standard British, and, in fact in all the ordinary gauges except the B. & S.

In view of the failure of so many attempts at gauge-making, and in view of the general desire for something better than any known gauge, why not do like the rest of the world, and designate sizes *by sizes?* A true word was said long ago by Miller, Metcalf & Parkin: "There is a very simple and easy way out of the whole snarl, and that is to abandon fixed gauges and numbers altogether." That is what other people do, or are coming to do. The English are more and more getting into the way of reckoning by mils, and the rest of the world, outside of the United States, has pretty generally adopted the metric system.

The gauge proposed to the Electric Light association is the one adopted by the German manufacturers some years ago. So far as I can learn, however, this gauge is not in common use by the Germans at present. Although I have been doing business with Germany for years, buying and selling, I have never seen the numbers of this gauge referred to in correspondence nor heard them mentioned by Germans in conversation. They always talk and write millimetres, and buy and sell by millimetres, just the same as other Europeans. Here you have, therefore, an attempt to introduce this identical gauge, the result being the adoption of millimetre measurement, pure and simple.

The name proposed for the gauge is also objectionable. "National Standard Electric Wire Gauge" is neither true nor appropriate nor convenient. It is inconvenient, because too long; inappropriate, because it conveys no idea of the system on which the gauge is based; and untrue, because the gauge is in no sense "National" It was German once, and is founded on a system French in origin but now international and world-wide. "Metric Gauge" is a name conveniently short, appropriate and true.

But as gauges have failed to meet the demand in America, and have been abandoned by the greater part of the world, would it not seem that their day is past, and that the thing to do is to adopt measurement by definite values? Admitting this, the question is which to take, mils or millimetres. The mil has the advantage of being understood by everybody, and of being already in use to some extent. Beyond this, all the advantage lies with the millimetre, for the following reasons:

1. It is the basis of all electrical units.
2. It is already in use by the whole scientific world.
3. It is used by the greater part of the world of business.
4. It is better and more convenient than the mil.

Reasons first and second are well-known facts, while the third seems not to have been fully appreciated, but is none the less true. Nearly all continental Europe uses the metric system; so also the whole American continent south of the United States boundary. In designating sizes of wire and sheet metals, however, the English system stubbornly disputed the ground, being in prior possession, and held its place in some countries for many years, but has now nearly disappeared from all countries whose language of trade is not English. Metric measurement has thus made steady progress in the world at large, displacing local and inferior systems. It may be hopeless to try to bring the kilo and the metre into general use in the United States, but the adoption of the millimetre for measuring wires and sheet metals would have the advantage of bringing the country into line with modern progress in this one respect, and of assimilating American trade usage to that of the greater part of the business world.

As to the relative convenience of the inch and the millimetre, it is to be noted that the mil, or thousandth part of an inch, is not small enough for the thinnest wires and sheets, while it is too small for the thicker sizes. For very fine wires, such as No. 38, B. & S. gauge (4 mils, 10-100 mm.), the unit of measurement should be small enough not to require subdivision to express any size required, and yet not so very small as to lead to a needless multiplicity of numbers. The mil does not fulfill this condition, for it must often be halved to express a required size. The hundredth of a millimetre, however, fills the bill perfectly. The successive sizes, 7, 8, 9, 10, 11-hundredths, etc., are all needed, and yet the differences are as minute as can well be measured for trade purposes; or at any rate if we can measure more closely we cannot draw wire more closely, and even for this degree of accuracy we must use diamond dies. Passing to larger sizes we find the mil too small and leading to too many numbers, while the millimetre is about right. The near equivalents of the ordinary sizes of telegraph wire are as follows: No. 4, 6¼ mm.; No.6, 5¼ mm.; No. 8, 4¼ mm.; No. 9, 3¾ mm.; No.10, 3½ mm.; No.12, 2¾ mm.; No.14, 2¼ mm. The sizes vary at first by just 1 mm., and then by ½ mm. It would cause no inconvenience to change these current sizes to 6, 5, 4, 3½, 3, 2½ and 2 mm. (The standard size in Europe is 4 mm.) Again, in the smaller copper wires (using now the B. & S. gauge), the current sizes and their near equivalents are: No. 12, 2 mm.; No. 14, 1½ mm.; No. 16, 1¼ mm.; No. 18, 1 mm.; No. 20, ¾ mm.; No. 22, ⅔ mm.; No. 24, ½ mm. The sizes differ generally by quarter-millimetres, and there would be no inconvenience in going by quarters above 1 mm., and by tenths below 1 mm. Let us compare these results with the mils representing the same sizes. Taking the telegraph wires we should have 243, 207, 169, 152, 138, 112 and 86 mils, and for the B. & S. gauge sizes mentioned we should have 80, 64, 50, 40, 32 and 25 mils. Now if mils are adopted it will be impossible to hold purchasers to the standard sizes. Some one will order 250, instead of 243, or 200 instead of 207, or 60 instead of 64, or 30 instead of 32, and so on. Keeping stocks of standard sizes will become very difficult.

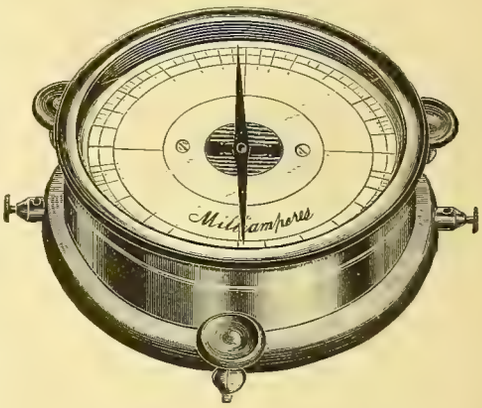
All the arguments, therefore, favor the millimetre, except one—that of familiarity and habit—and yet this one may possibly outweigh all the rest. Unless you can bring into actual and general use the system chosen, all your resolutions of "adoption" might as well be thrown to the winds.

The millimetre is infinitely preferable to the mil, as the kilo and gramme to pounds and ounces, the kilometre, metre and centimetre to the mile, foot and inch, and the dollar to the pound sterling or rupee—or even to the franc, mark or florin. But habit and custom—there's the trouble—

"Custom lies upon us with a weight
Heavy as lead, and deep almost as fate."

Electrical Measurement of Medical Currents.

Many medical batteries are constructed without sufficient attention to producing currents which will do the work expected of them. The time is passing, however, when even a physician will apply electricity without more definite information concerning the force he is using than has contented him in the past. Very good test instruments are now provided, intended expressly for medical work. Ampere strength being too great for convenient division, it has been agreed to graduate the instruments employed to milliamperes, the measurement always being made with the patient in circuit. Among the many devices to be found in the market the one illustrated in accompanying cut, manufactured by the McIntosh Battery Co., of Chicago, commends itself for its simplicity and because with ordinarily



careful usage it does not get out of order. More expensive and delicate instruments are offered, but unfortunately all of them are deteriorated by the earth's magnetism and must be readjusted at frequent intervals by an expert electrician. This adds an element of uncertainty as well as of expense, which frequently impairs their usefulness for medical work.

Some remarkable and unexpected information has been obtained from this milli-ampere meter, namely, that with some of the electrodes commonly employed the amount of current actually passing through the patient's skin is almost nil, which forces us to the conclusion that many of the wonderful recoveries which have taken place under electrical applications have really been wrought by the imagination. Again, in operations for the destruction of tumors, strictures and the like, it is found that a current of much less strength will accomplish the work, with less danger, and equally favorable results, when the distant pole has a large, warm, moist conducting surface closely applied to the skin. Paralytics in whom electric sensitiveness has been entirely abolished, have been given treatments in which the currents employed were believed to be of such strength as to excite surprise that they did not decompose the tissues. It is found in these cases that scarcely any electricity penetrates the muscles, which, owing to the feeble circulation, have become almost non-conductors. Again, the amount of electricity which can safely be employed with the human body in circuit has been a matter of doubt, therefore when the tissues have been unusually resisting to the contractile power of the current, too feeble applications have been made, the failure to bring about recovery being attributed to the agent employed rather than to imperfect treatment. The brain is extremely sensitive; so are the organs of the special senses. The practitioner who does not measure the force employed may to-day give relief, using a given number of cells for a definite time. To-morrow he may, while using the same number of cells for the same length of time, aggravate all the symptoms and discourage his patient from continuing treatment, because his battery is freshly charged, or the condition of the patient is such as to offer little resistance to the current.

The day of precision in electric dosage has arrived, and for safe and efficient work a milliampere meter of at least approximate accuracy is demanded.

Theory of Telephone Cables.

DR. V. WIEILISBACH IN ELEKTROTECHNISCHE RUNDSCHAU.

PART I.

With the spread of telephone systems the use of telephone cables becomes a continually greater necessity. In large cities it is becoming impossible to bring all wires together into an exchange aerially. For large systems several exchanges are connected with one another by which an excessive number of wires running to one center is avoided, but operating costs are increased. To avoid this, exchanges with 6,000 to 10,000 wires each have been established in America, a thing possible only by using cables. The use of underground cables is so advantageous in many ways that their introduction is justified, even though there may be no special urgency for them. Underground cables are not exposed, wires do not break, cross, etc., and in good telephone cables induction, disturbances due to bad splices, bad insulation, terrestial magnetism and molecular changes by temperature and elasticity are entirely obviated. There are, it is true, disadvantages such as current modifications and limitations, so that transmission becomes impossible, when a cable has reached a certain length. It is my intention to describe concisely this influence of telephone cables upon the currents passing through them. The forces operating in cable transmission are the resistance, capacity and induction of the conductor. Induction in straight copper wires is very small, so that if the capacity is large, as is the case in telephone cables, the factor of induction may be disregarded, provided neither conductors nor armature contain iron. My theory requires that in the matter of capacity the electricity absorbed be constantly proportional to the electric force at any given place. This premise is not absolutely true, as the insulating materials when electrified act like magnetized iron and similarly change in condition after a certain lapse of time. Furthermore a backset, so-called, has been observed in the discharge of cables and condensers, analogous to residual magnetism in iron. Nevertheless deviations from my premise are scarcely perceptible in telephone cables, as changes in potential and charges are very small. Telephone cables showing a decided backset after small charges would be useless. We assume for that reason, that, in the following, insulating material only slightly susceptible to polarization such as paraffine is used.

"The usual formulas which are current in regard to the propagation of electricity in cables, refer to submarine telegraph cables of very great lengths. They are usually in series which rapidly converge for long cables, but are not applicable to telephone cables in which only short distances are taken into consideration. I have succeeded in deriving a formula from the well known treatise of Mr. Kirchhoff on "The Theory of Electric Motion in Submarine or Underground Telegraph wires" (monthly report of the Academy of Sciences at Berlin, Oct. 29, 1877), which in concise and comparatively simple form describes the process of transmission of electric waves through a cable. By specializing the general equations of that treatise and by introducing the usual signs, I get the following value for the strength of the current at the end of the cable, if at its beginning we have as the electro motive force of a simple harmonic wave

$$E = A \cos nt$$

$$i = \frac{A \cos (nt+\delta)}{W} \qquad \frac{\sqrt{2.k}}{\sqrt{[e^{k}+e^{-k}-2\cos k]}}.$$

In this

$$k = 2\sqrt{2n\pi C.W}.$$

n is the number of oscillations in the transmitted electric wave.

W is the resistance of the entire cable in ohms (10^{7} [cm gr sec]),

C is the capacity of the entire cable in microfarads (10^{-16} [cm gr sec]).

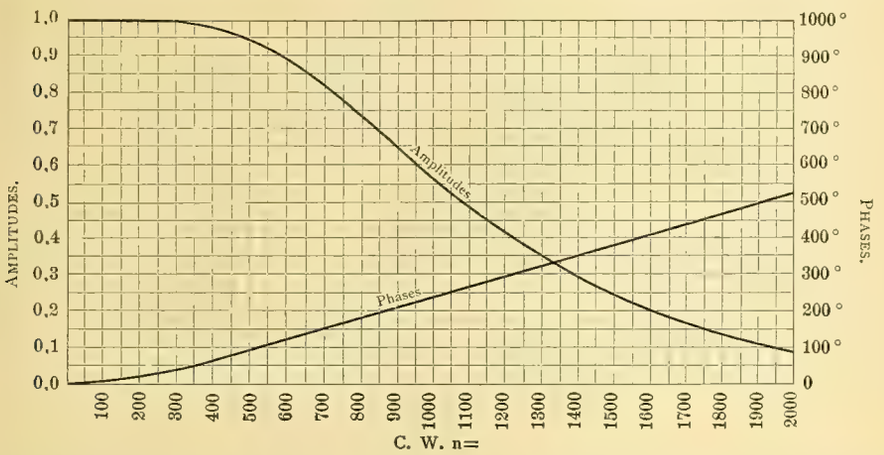
δ is the phase of the motion $= \operatorname{artn} 1 - \eta$.

in case $tn\ \mu = \frac{e^{k}+e^{-k}}{e^{k}+e^{-k}} tn\ k$.

The conditions which are at the basis of this equation are the following:

1. The electric conductor is stretched straight and no masses of iron are near it, so that the factor of induction opposed to the capacity is inconsiderably small.

2. The conductivity of the insulation is as opposed to the conductivity of the copper zero. Now in good telephone cables the insulation is at least 1000 megohms per km. From this we can calculate the conductivity of the insulating medium λ approximately at about 10_{26}, while that of copper can be made equal to 6000.



3. If μ signifies the dielectric constant of the insulation, and λ its conductivity, then λ as opposed to $2n\mu$ is inconsiderably small. Now in case of a good cable which is insulated with paraffine or gutta-percha, $\lambda = 10-^{26}$, $\mu = 10-^{21}$, so that even for the relatively small number of oscillations $n=50$, the following obtains:

$\frac{\lambda}{2n\mu} < \frac{1}{10000}$. There are indeed cables in which λ has a considerably greater value, while μ does not vary to any extent In that case this condition would not be fulfilled with adequate exactness and the formula would become considerably more complicated.

On the other hand in good cables these conditions are always fulfilled, and for those our formula is exactly correct."

In the propagation of electric waves through a cable, two things are to be taken into account.

1st. The speed with which the wave progresses in the cable and which is determined by the phase δ.

2d. The gradual diminution of intensity in its progress.

It is instructive to observe two extreme cases upon which Kirchhoff has touched. If the resistance and capacity of the conductor are very small, then the diminution in intensity of two consecutive amplitudes of the same wave are of no consequence.

The motion propagates itself with greater speed and with constantly uniform intensity through a cable, turns at its end and runs back through the conductor, turns again at the beginning of the cable and again traverses its length a great number of times back and forward before it slowly dies out. The speed of the motion is, for this reason, approximately that of light in a vacuum, that is, about 41,950 geographical miles per second, and is thus so great that the motion cannot be perceived with ordinary instruments. The motion of an electric wave in such a conductor is analogous to the motion of waves which are caused by agitating a music string.

If the resistance of a cable and its capacity become continually larger, the speed of the motion becomes continually less, and the diminution of intensity continually greater. The oscillatory motion disappears gradually and electricity finally propagates itself like heat through a thin rod of metal.

Telephone cables have relatively very large capacity, but are usually of short lengths, and neither of the cases mentioned above need usually be considered. But the diminution of intensity will turn out to be a more important factor.

In order easily to determine the intensity of a current over a given length, and with a certain quality of cable, I have calculated it for different values of the factors n. C.W., and have drawn in the following figure the corresponding curve.

A Corner on Electric Light Carbons.

For some months there has been an effort by certain parties to control the market in electric light carbons, and as we go to press the matter has assumed a new aspect. These carbons have for a long time been supplied chiefly by two firms in Pittsburg, three or four in Cleveland, two in St. Louis, and two or three in New England. Two months ago a combination was formed, with headquarters at Cleveland, embracing all the principal factories, and the price of carbons advanced from $10 and $12 per thousand to $20 and $25. As these carbons are chiefly made from the coke of petroleum and naphtha, it has been proposed by a syndicate, composed of some of the electric light companies, to take the entire petroleum-coke product of the Standard Oil company and manufacture their own carbons. This product is 20,000 tons per year, and it is reported that it has been offered to the syndicate at $8 per ton, and that the offer will be accepted as soon as the various parties interested can signify their assent, and that the new factory will be located in New York city.

It seems that $20 and $25 per single thousand is not considered an unreasonable price for good carbons, but the Cleveland combination would make no wholesale rates to large consumers—charging them just the same as those who bought by the single thousand, and this has been one chief cause of dissatisfaction. As the Standard Oil company seems to be the principal producer of the coke, it is thought that the new arrangement will give the syndicate virtual control of the market, and leave the Cleveland combination and those depending on it out in the cold.

Thomas A. Edison's Ingenuity.

At the recent banquet of the Chicago Electric Club, a friend of Thomas A. Edison related an incident which well illustrates his quick wit and ingenuity. During the progress of some of his experimental work it became necessary for him to know the exact volume of the interior of an incandescent lamp. He called two expert mathematicians, inquired if they could calculate the volume and upon receiving ready affirmatives, set them at the task. For some time they struggled with the problem and then brought the results of their calculations to him. Meantime as the easiest, quickest and most accurate way of obtaining the information Mr. Edison had filled one of the lamps with water, poured the water in another vessel, measured it and had accurately determined the volume. When the mathematicians brought their results to Mr. Edison, he found that each varied from the other and from his results. He set them at work again but at the close of an hour's or more labor they still varied. Then he showed the tired mathematicians how easily he had attained the result and how accurate his figures were. Their confusion may perhaps be better imagined than described.

National Electric Light Convention.

The convention of the National Electric Light association will be held at the Parker house, Boston, August 9th, 10th and 11th. The indications are that the attendance will be large.

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Western Electrician.

In presenting the WESTERN ELECTRICIAN, and explaining its mission, it is unnecessary to dwell on the marvellous achievements in the electrical field during the past few years. The telegraph, the telephone and the electric light have followed in quick succession. The electric motor is at hand, and its promise of commercial success is as great as that of its predecessors. But these four great electrical accomplishments are not all, by any means. Apace with them has been the development of a host of minor electrical appliances, many of which have become distinct branches of industry. To-day the development and manufacture of electrical appliances command more thought, more labor, more capital than almost any other department of trade. Yet we stand only at the edge of a comparatively unknown field, the exploration of which is going on more rapidly than ever before.

While keen minds and skillful hands, the world over, have contributed to the researches and inventions which have placed applied electricity in its present position, it is in the United States that these applications have reached their greatest commercial success, and no part has shown greater activity than the west. It is a question if any other portion of the country has equalled the west during the last eighteen months. Certain it is that in this section electric light manufacturers have found the most extensive market for their products. Certain it is that the promoters of the telephone have found it easier to acquire paying subscription lists in small western towns than in similar towns in the east. If we mistake not, a western city enjoys the distinction of being the first in America to adopt and practically operate an electric street railway system of more than one or two cars. It is in the west that telegraph companies make their heaviest earnings. To-day the west is the great electrical market of America. Its advancement to this position has been rapid and sure. Many eastern manufacturers discovered the tendency of trade long ago, and, realizing the impossibility of handling their western business from remote distances, have either moved west or established important agencies in our larger cities. In every case the wisdom of the move has been proven, and in many instances it has been found that a larger and more profitable business has been done in the western department than at the home office. The west, too, is the home of a number of the largest electrical concerns in the world. They have realized the benefits of proximity to a good market.

No local pride dictates these words. They have not been written with the intention of disparaging any other section. The facts, however, can not be controverted; and we are but reflecting the experience of the past in stating that the west is worthy of the closest cultivation by manufacturers and dealers in electrical appliances.

Notwithstanding the remarkable activity in matters electrical in the west, western electricians and manufacturers have been dependent on eastern publications for their literature, and for channels through which inventions and manufactures could be brought to public notice. The need of a representative western electrical paper has been apparent for some time; the subject of establishing such a journal has been urged by western electrical men, and their assurances of hearty co-operation and substantial support have not been wanting.

The warmth of the welcome with which the project of issuing the WESTERN ELECTRICIAN has been received is strongly evinced by the extent of our advertising columns. Our reading columns give a foretaste only of what is to be provided in that department. We believe we are well equipped for the work. With the auspices of the undertaking, and the incentives before us, we hope to place the WESTERN ELECTRICIAN not only in the foremost rank of papers of its class, but in the lead. To accomplish this end no thought, labor or money will be spared.

At the outset we wish to define our position. No man connected with the WESTERN ELECTRICIAN is bound to any other electrical enterprise; we are therefore in a position to publish an independent, unbiased and honest journal. No newspaper is worthy of the name unless it provides the news. It will be our endeavor to place before our readers the thoughts, experiences and accomplishments of those interested in the department of electrical investigation. Not only is our editorial staff composed of practical electricians and writers of experience, but our correspondence will be from among the leading electricians and scientists of this country and the old world. We have planted our standard high, and we confidently look forward to the time when the weekly receipt of the WESTERN ELECTRICIAN will be more warmly welcomed than this, our first number.

The next annual meeting of the Association of Railway Telegraph Superintendents will be held at the Tremont house, Boston, at 10 a. m., Wednesday, July 13th. A room has been secured for the exhibition of mechanical and electrical devices used in railway work. Parties desiring to exhibit such apparatus can be assigned space by communicating with L. F. Sheldon, Supt. Tel., Missouri Pacific Ry., Sedalia, Mo.; G. L. Lang, Supt. Tel., N. Y. & N. E. Ry., Boston, Mass.; C. E. Topping, Supt. Tel., Long Island Ry., Long Island City, N. Y., or with G. E. Simpson, Supt. Tel., C. M. & St. P. Ry., Milwaukee, Wis.

WE believe we are not flattering ourselves when we declare that we are handsome from a typographical point of view. The veteran printer announced his ability some months ago to give us a handsome dress for our debut. We think he has kept his word.

THE twenty-ninth annual report of trade and commerce of Chicago for the year ending December 31, 1886, compiled for the board of trade by George F. Stone, secretary, has just come from the hands of the printers. The report shows the steady and remarkable growth of Chicago and every line exhibits exhaustive and careful work on the part of the compiler. The document is valuable from a statistical point of view.

The first installment of an article on the theory of telephone cables, from the pen of Dr. V. Wietlisbach and translated from a recent number of *Elektrotechnische Rundschau* appears in this number. Dr. Wietlisbach is at the head of the Swiss government telegraph system and is an able writer, as the article shows. However, the entire theory is not acceptable to a cable expert of this country whose name is known throughout America and Europe, and at the conclusion of Dr. Wietlisbach's article we shall have the pleasure of publishing some comments, the perusal of which will well repay the reader.

THE vigorous argument of Mr. Welles in another column against the adoption of the National Standard Electric wire gauge is well worth reading. Mr. Welles has had large experience in buying and selling wire and is in position to present a good argument in favor of the millimetre measurement of wire. As will be seen, he deduces four points in favor of the millimetre as opposed to the mil; first, that the millimetre is the basis of all electrical units; secondly, that it is already in use by the whole scientific world; thirdly, that it is used by the greater part of the world of business; fourthly, that it is better and more convenient than the mil.

ROCHESTER, N. Y., has just contracted with three electric light companies to light the city for five years. The details will be found in another column. The cost of lighting the city for a series of years past has been in the neighborhood of $90,000 to $100,000 annually. Until about 1881 the lighting of the city was done by gas and kerosene. Since that year electric lighting has gained a strong foothold, and year after year has seen larger and larger districts of the city illuminated by electricity. The total amount of the contracts with the three companies, without figuring on any increase in the number of lights, is $291,299.25, which is an average of $58,259.85 per annum. These figures are significant in the showing they make for the steadily increasing popularity of the electric light and are especially significant in view of the fact that the three electric light companies have been in competition with three gas companies.

THE "bridge nuisance" referred to in another place in this issue in connection with plans embodying the use of the electric light or telephones for the purpose of remedy is a source of exceedingly great dissatisfaction to the citizens of Chicago, and yearly both the nuisance and the dissatisfaction are increasing. The nuisance is too well-known to citizens and visitors to need description. How many business engagements are delayed, how much traffic is held and how much time is lost every day by bridges being opened are matters for speculation only. The nearest approach to a statement of the nuisance is only to be had by approximating the number of persons that cross Chicago bridges in a day and the number of vessels that pass the bridges. The board of trade report just issued, shows that for the year ending June 30, 1886, 22,096 vessels arrived and cleared from the port of Chicago, necessitating, of course, the opening of some bridges at least the same number of times. But a proportion of these vessels load and unload at several different docks, necessitating the opening of some bridges at least two or three times additional for each of these vessels that go to different docks.

June 19, 1886, at the request of Ald. Thomas C. Clarke, Captain Hubbard of the police department stationed an officer at Clark street bridge and another patrolman at La Salle street tunnel for the purpose of keeping an account of the number of pedestrians and vehicles that chose

those routes for passing the river. The count was kept for twelve hours—from 6:30 A. M. to 6:30 P. M. Between those hours 30,159 pedestrians, 4,785 vehicles and 1,380 street cars passed over the bridge. The average of the number of persons to each car was figured at 20, making 27,600 persons that passed over the bridge in cars, or a grand total of 63,924 persons that passed over the bridge in twelve hours. The total number that chose the tunnel in the same hours was 4,858.

With this count for a basis, some very startling figures can be adduced—figures that are well-nigh incredible and yet made in such a conservative way as to be of little value except for the purposes of approximation. Calling the season of navigation six months only, excluding Sundays from the calculation, and calling the day only twelve hours long, we have 158 days, which, multiplied by 63,924, shows a travel of 10,099,992 persons over one bridge only in the time specifically described. Allowing an average of one minute per day, or say two and one-half hours for the season, delay for each person by open or broken bridges, we have a total of 25,249,980 hours lost on account of the bridges in the time specified. But there are 30 other bridges in Chicago over the river—none of them has the amount of travel that Clark street bridge has, but for the sake of carrying out the calculation we will allow each of the other bridges one-tenth the travel of Clark street bridge. This makes an aggregate of 100,099,920 hours lost in the time stated by the bridges being open. This time has value, and for the purpose of getting an idea of that value, we will make the standard twenty cents an hour, and at this rate, $20,199,984 is lost in the time specified on account of the "bridge nuisance."

Chicago Electric Club.

On the 20th day of last May, the secretary of the state of Illinois, issued to Chas. J. Van Depoele, F. S. Terry, Chas. A. Brown, Wm. J. Buckley, Aaron K. Stiles, W. J. Armstrong, W. A. Kreidler, F. G. Beach, J. P. Barrett, Chas. D. Shain, B. E. Sunny and Joseph Uhrig articles incorporating the Chicago Electric Club, and in the document specified that the object of the club was the promotion of social intercourse, the diffusion of knowledge among those interested in electrical matters and to provide members with the conveniences of a club house. A few days after receipt of the incorporation articles, an organization of the club was effected and the folfowing officers elected for the ensuing year:

President: A. K. Stiles.

Vice-presidents: C. A. Brown, J. P. Barrett, B. E. Sunny, F. G. Beach.

Secretary: W. A. Kreidler.

Treasurer: F. S. Terry.

Managers: C. A. Brown, F. S. Terry, W. A. Stiles, W. A. Kreidler, W. J. Armstrong, W. J. Buckley, J. P. Barrett, Chas. D. Shain, B. E. Sunny and Wm. J. Lloyd.

Much interest was manifested in the club and applications for membership came pouring in. June 9th, a meeting was held in the Grand Pacific hotel parlor and the attendance was twenty-nine. A proposition to have a banquet June 18th was unanimously received. The committee in charge: Messrs. H. Ward Leonard, J. L. Barclay and A. H. Brown, united in an effort to make the banquet a success from a gastronomical point of view at any rate and as the fifty diners present can testify, were successful to an eminent degree. By that date the roll of membership had increased to about eighty, and since then a large number of gentlemen have sent in their names with expressions of desire to unite with the club. The prospects for a strong and influential association are very flattering.

A committee on permanent quarters have been actively engaged in looking for a home for the club, but their report will not be ready to present until the next meeting. The prospects, however, are that the club will be settled in permanent quarters within two or three weeks.

A meeting of the club has been announced for Monday evening, July 11th. The place will be named hereafter. The committee in charge are making arrangements for papers on subjects that will have much interest for members of the club.

Electricity as a Mode of Motion.

By Philip Atkinson, Ph. D.

PART I.

The elementary components of the natural universe are matter and energy. Matter in the abstract is inert; it can move or act only as actuated by energy, and energy in the abstract is incapable of movement or action except through the medium of matter. But we have no actual knowledge of either in the abstract, nor can we separate them, and all our conceptions of them in this respect are theoretical. All matter, even when apparently inert, is under the influence of energy, both in respect to its mass and its molecules. The apparent inertness of the mass is only relative. A steel rail, resting in its place on the track, is relatively inert with respect to its immediate surroundings, but as a part of the earth it partakes of the earth's motion as a mass, and close observation and measurement show that its dimensions are subject to continual variation with continual change of temperature—the result of expansion and contraction; which proves that its molecules are in continual motion. The same is true of the column of mercury or alcohol in the thermometer, in which change of dimension is more apparent.

All matter is subject to change of dimension with change of temperature, but not all in the same degree. In many kinds, as baked wood, bone and ivory, it is almost imperceptible, requiring delicate instruments to detect it; while in others, as gas, vapor and mercury it is more prominent; so that if change of dimension be accepted as proof of molecular motion, it must be admitted that such motion is a constant, natural condition of all matter, since an absolutely stationary temperature may be regarded as a practical impossibility. Hence, the absolute inertia of matter, either in its mass or its molecules, must be regarded as a purely mental conception, having no existence as an actual fact.

But even if the maintenance of an absolutely stationary temperature could be demonstrated as a possibility, such demonstration would not disprove the continuous molecular motion of matter, since it has been fully demonstrated that heat itself is a mode of motion; so that to admit the constancy of heat in matter is to admit the constancy of molecular motion.

It is not the purpose of this article to adduce the proofs on which this theory rests. It is sufficient to state that it is maintained by the highest scientific authority and accepted as a fundamental doctrine of modern science.

Common observation shows that nothing is so hot that it cannot become hotter, or so cold that it cannot become colder, heat and cold being merely convenient relative terms to express different degrees of heat. Steam generated under a pressure of several atmospheres is much hotter than when generated under a pressure of one atmosphere. Cold iron is relatively warm as compared with colder iron. Even ice itself possesses a certain degree of heat.

The theory of sound as an undulatory movement of the air is too well established to require the presentation of proof, and the theory of light as another form of undulatory movement has also been accepted as a well established doctrine. But in regard to the nature of electricity scientific opinion has been greatly divided, and no theory yet proposed has been so free from objection as to be generally accepted. But electric development during the last ten years has done much towards the settlement of this question, and the theories and opinions of the great electricians of the period immediately previous are yielding to the steady pressure of recent investigation, just as their investigations modified or displaced former theories and opinions.

Observation shows that electricity may be developed in every kind of matter, from which we may reasonably infer that it is a universal property of matter in the same sense as heat. In proof of this we find that it may be promptly developed in the numerous class of bodies known as non-conductors by means of friction, and in the class known as conductors, which embraces all other bodies, by the same means, if they are first properly insulated. As an example of the latter class we may select a brass rod; let it be insulated and subjected to friction from another insulated body, and electricity is rapidly developed, as shown by attraction, and by the spark and snap. That this electricity is developed in the rod itself, and not derived from the body by which the friction is produced, is proved by using a brass friction-brush or brass in any form by which a light contact is obtained. The Varley and Töpler electric machines are examples of this. In the Armstrong hydro-electric machine we have a very notable instance of electricity generated by the friction of condensed steam, emitted through metal pipes tipped with wood. From these, and numerous other instances which might be adduced, we may conclude that electricity can be developed in all bodies by friction; its development in conductors, when insulated, being equally as practicable as in non-conductors.

The generation of heat by friction is coincident with that of electricity, and the heat continues to increase long after the electric development has attained its maximum. If the friction be sufficiently increased in the case of a solid body, as a metal, light is developed, the metal becoming incandescent. Thus, by the agency of friction, certain phenomena are produced, the first of which we call electricity, the second, heat, and the third, light. The last two we designate as modes of motion. Why not the first also? The friction is a result of mechanical energy acting through matter; the energy in this form disappears, and is reproduced as electricity, heat, and light. Each of these then is a different manifestation of energy acting through matter as its medium.

Since these manifestations are different, it is evident that each must have its own peculiar form of molecular motion; that the electric movement, which becomes prominent first, is the most easily and rapidly developed, and essentially different from the heat movement which, though coincident with it, is developed more slowly; while light is not produced till the movement has assumed great intensity, the light changing from red to white as the intensity increases.

In the battery we have electricity produced by chemical reaction, and heat also as a coincident result. The chemical reaction is itself a mode of atomic and molecular motion by which atoms and molecules interchange and form new combinations; and since the incidental heat is admitted to be a mode of motion, we may reasonably infer that the more prominent electricity is another mode of motion; the energy disappearing in the chemical mode, reappearing in the heat and electric modes—molecular motion in one form being transmuted into molecular motion in the other two forms.

In the dynamo we have electricity generated by mechanical action combined with magnetic, electricity and magnetism reciprocally producing each other. Magnetism is admitted to be the result of a certain molecular arrangement in the substance of the magnet, and in the soft iron of the electro-magnets of the dynamo this molecular arrangement undergoes constant disturbance, producing a series of momentary electric currents with such rapidity as to maintain an apparently constant electric action. Hence we must infer that these magnets are in a constant state of intense molecular motion; and since magnetism and electricity are always coexistent and reciprocal, we are warranted in the conclusion that they are of the same nature—*sui generis*,—and that if one is a mode of molecular motion the other must be. And this theory gains additional strength from the fact that here again we find heat generated as an incidental result, to such an extent that special arrangements are required to keep the dynamo from being injured by over-heating.

Telephone Statistics.

The annual statement of the American Bell Telephone Company giving the statistics of the telephone exchanges in operation in the United States on the first of January, 1887, has just come from the press. Appended is a comparative statement which shows for itself the extent of the company's interests in the United States:

	1885.	1886.	1887.
Number of exchanges	772	747	736
Number of circuits	107,440	112,067	121,260
Number of miles of wire	101,734	114,046	128,231
Number of employes	5,168	5,438	5,843
Number of subscribers	134,847	137,750	147,068

A New High-Speed Engine.

We illustrate herewith the new high-speed automatic cut-off engine, just being introduced by the Woodbury Engine company, of Rochester, N. Y. Fig. 1 is a view of the steam chest and governor side of engine; Fig. 2 shows a horizontal section through cylinder, steam chest, valve and relief plate, and Fig. 3 a vertical section through the same parts. The engine, as will be seen, is of the self contained, single valve type, and the regulator is of that class in which the point of cut-off is controlled by moving the eccentric across the shaft, thus varying the valve travel. Two centrifugally acting weights are employed, to one of which the eccentric is attached. The centripetal or opposing force is furnished by a single spiral spring, the two weights being connected by a link. The chief characteristic of the governor is in the adjustment which enables the centrifugal and centripetal forces to be so balanced at all positions that the fluctuations in speed from light to heavy load, and with great ranges in steam pressures, are confined within remarkably small limits. This is accomplished in the following manner: The link which connects the spring to the main weight has a series of holes corresponding with the same number of holes in the weight itself, as shown in Fig. 1. There are seven holes, and the sustaining pin which takes the strain of the spring fits through any hole in the weight and the corresponding hole in link. The relations of spring tension to the weight of the centrifugally acting parts may be such that as the weights move outward, the effective force of the spring will increase more rapidly than the centrifugal force of the weights. In this case, the speed will not be controlled within the proper limits. Or the reverse may be the case; the centrifugal force increasing faster as the weights move outward faster than the power of the spring; when the engine would pulsate or "race." In the first named conditions the pin is to be moved one or more holes farther outward, and in the latter the pin is to be moved farther inward, or nearer the spring. The nearest approach to isochronism or perfection of regulation is just inside the point at which vibration appears, and this point is readily reached by the adjustment provided. It should be understood that the adjustment once made for each engine becomes permanent and does not have to be changed to meet any other conditions of load or pressure. The initial tension of spring remains the same in all positions of the sustaining pin. Another good feature about this regulator is that the pull or strain on all the parts is always in the same direction, and they can not be affected by lost motion, or wear so as to rattle.

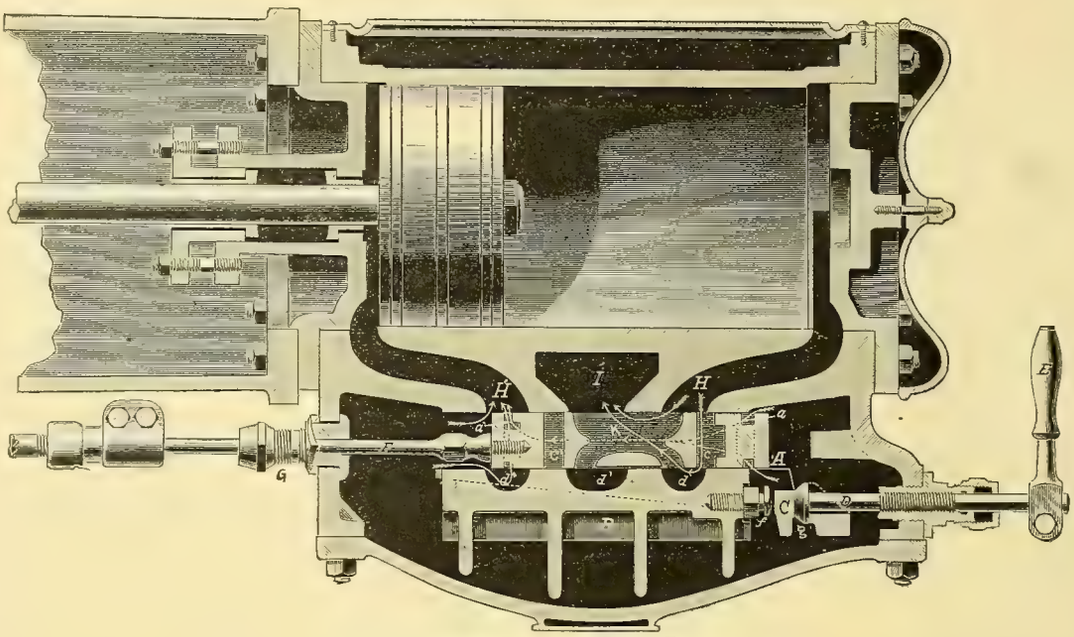

Fig. 2.—Woodbury Electric Light Engine.

The valve is of the flat slide form, and is wholly balanced by a relief plate on the back, so as to work in equilibrium. The relief plate has cavities corresponding with the cylinder face, and the valve slides between the two surfaces. The pressure on the relief plate comes upon a double or forked wedge at top and bottom, shown in dotted lines. The longitudinal movement of wedges control the relative position of the faces, and the adjustment of wedges is made by two screws, not shown, which pass loosely through the head or cross-piece of the wedges and tap into the relief plate. The handle E and screw D are not for adjustment, but to provide a means of temporarily separating the faces in starting the engine until all the parts are thoroughly warmed up, when the relief plate is let down into its normal working position by throwing back the handle. The adjusting screws which operate the double wedge are each provided with a collar, on which are cut one hundred notches; and as the movement of the screw to the extent of one notch represents a movement of the relief plate from or toward the valve of but 1-10,000th of an inch, the adjustment is micrometrical in its character, and is very simply and easily made. There being, however, no pressure upon the faces, the wear is very small in amount, and takes place so slowly as to require adjustment but once in several months.

Fig. 2 shows the manner of admitting and distributing the steam. The admission takes place, as will be seen, at four points at the same time. In the position of valve shown, steam is entering past the end of valve, both directly and through cavity in relief plate, whence it passes through auxiliary steam port a' into cylinder. Steam is also entering at the opposite end of valve at two points and passing through supplemental passages b, b' Fig. 3 into port a' and cylinder. The cut-off, of course, takes place at four points at once also. For the exhaust an auxiliary port is provided, so that it takes place at two points, as shown by the arrows. With this valve the nearest approach to boiler pressure is realized. The cut-off takes place sharply, and the release is prompt, the exhaust reaching the atmosphere without back pressure, even under the heaviest loads.

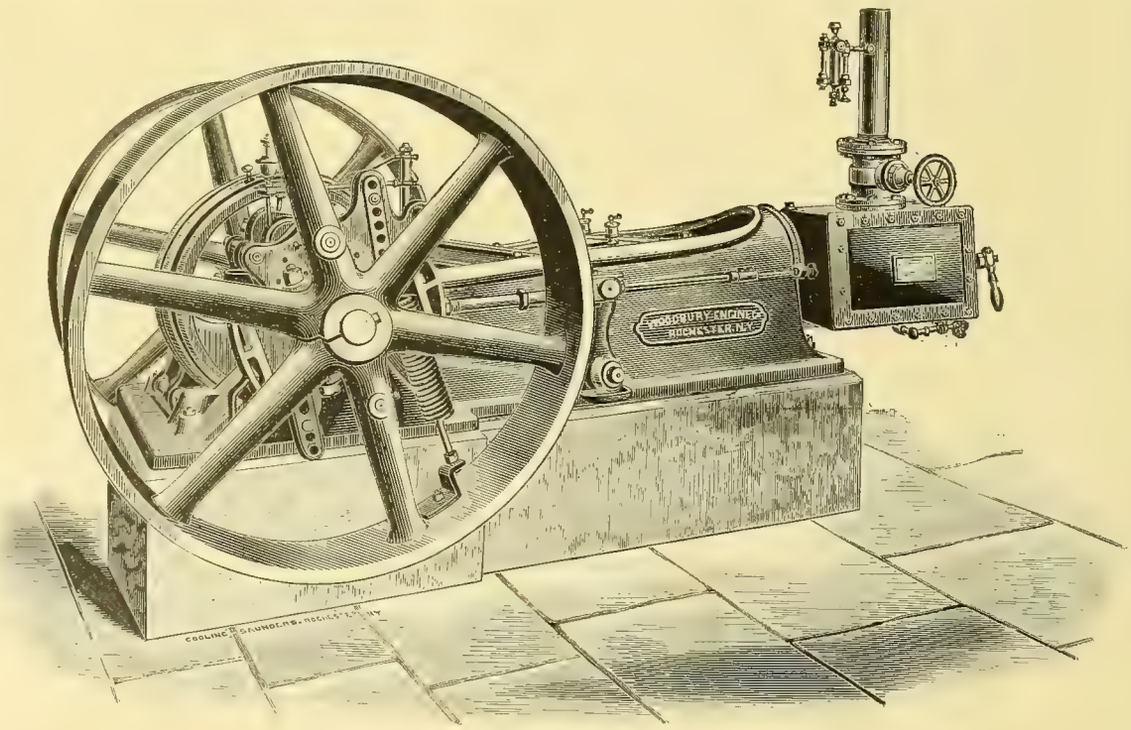

Fig. 1.—Woodbury Electric Light Engine.

The shaft and pin are formed in one solid forging and the counter-balancing disks are held to cranks with wrought iron clips passing around the cranks, and secured with nuts. The cranks are turned off at the end for the disks, which are bored out to fit, and the disks are therefore removable, and when replaced will run true. This is an important advantage in case it becomes necessary or desirable to true up the pin in a lathe.

The bed is massive, though symmetrical in proportion, and the makers have shown a determination to secure absolute rigidity in this important part. The wearing surfaces throughout are unusually large, and the workmanship of the highest grade.

The engine has been designed to meet all of the requirements of electric lighting, including long, continuous runs, heavy duty, the securing of a high degree of economy and close regulation. The makers attach great value to the feature of adjustment described in the regulator, by which it is possible to keep the variations in speed within one per cent. from the lightest to heaviest load up to full capacity of engine. The variation in speed is controlled within the same limit with changes of steam pressure from forty to eighty pounds, or with any range of working pressure, when the point of cut-off is such as not to exceed the capacity of engine at the lowest pressure, the maximum cut-off being at about three-quarters stroke. It is quite as important that a regulator should be capable of meeting changes of steam pressure, as changes of load, if it is intended to govern closely, for absolute uniformity of boiler pressure it is impossible to maintain.

Several sizes of this engine are now ready for the market, and the other sizes are fast being completed. Those now in use are giving the highest satisfaction, and there is no doubt that this engine possesses meritorious points which will be appreciated by the electric lighting community.

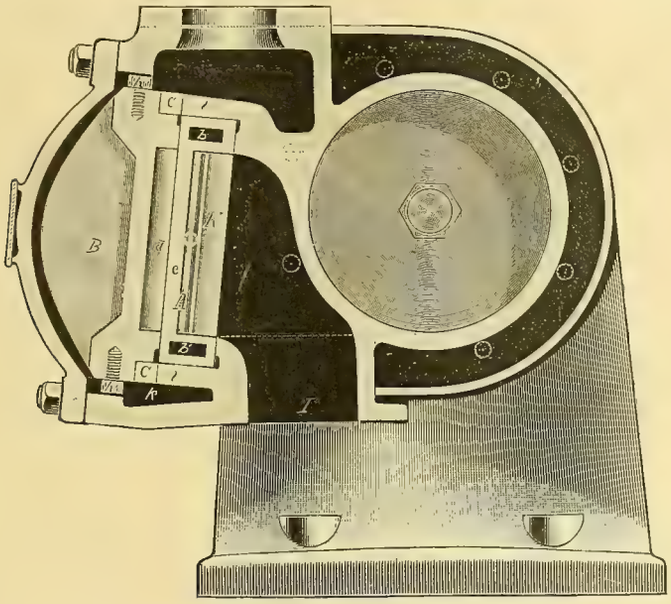

Fig. 3.—Woodbury Electric Light Engine.

Personal Paragraphs.

F. P. Fish, of Livermore & Fish of Boston, Mass., stopped in Chicago a few days ago on his return from a trip through Texas, in the interests of the American Bell Telephone company.

Chas. S. Pease, formerly of Chicago, now manager of the Westinghouse Electric company of Pittsburgh, Penn., has taken unto himself a wife. Congratulations and well wishes from western friends are numerous and hearty.

Charles Heisler, president to the Heisler Electric Light company of St. Louis, Mo., is expected home this month from a European trip.

W. H. Brenner, the Cincinnati superintendent, of the Edison Illuminating company, has started for Tokio, Japan, to superinted the erection of an 8,000 light plant that is to be installed in the royal palace.

E. M. Barton, president of the Western Electric company, is about to leave on an extended trip through Oregon. It may be that he will visit Alaska before his return to Chicago.

H. D. Sears, a graduate of the Boston Institute of Technology, L. K. Comstock, a graduate of Ann Arbor, and Ayres D. Lundy, a graduate of Cornell, are recent acquisitions to the office force of the western department of the Sprague Electric Railway & Motor Co.

Luxury of Modern Traveling.

The train of Pullman sleepers that make up what is called the "limited," running from Chicago to New York and return over the Pennsylvania system, is without question the finest in all its appointments of any train in the world. All the art and skill of the Pullman company have been exerted in the effort to surround the traveler with the conveniences of home life and at the same time provide luxuries that many a traveler will not find at home. The fittings throughout are truly palatial. The cars themselves are marvels of elegance, yet withal are built with that solidity that characterizes this company's products. The cars are connected with each other by a bellows-like arrangement, so that a traveler can walk from one end of the train to the other without stepping on a platform and wrestling with a cinder laden tornado that threatens to sweep him from his foothold. If a gentleman feels the need of a barber, he finds a little nook devoted to the tonsorial art; if he wishes to write, he finds an escritoire; to read, a well-selected library; to smoke, an elegant apartment; to eat, a magnificent dining-room and choice viands. In fact, every want that can be supplied is provided for.

The electric light is the latest acquisition. For a fortnight the light has been in use, and it is giving the best satisfaction. Each sleeper is provided with twenty-three sixteen-candle power incandescent lights, and the current is supplied to each car independently by a storage battery carried underneath. The arrangement is admirable. All the lights in the main part of each sleeper are controlled by a single switch, and the arrangement of the switch is such that each lamp can be burned to a quarter, a half, three-quarters or full capacity. The lights in the vestibules and state-rooms are independent and can be turned on or off at will. Any of the lamps can be taken from their sockets, and if a traveler, troubled with insomnia or a hearty dinner eaten at too late an hour, after he has retired wants to read in his berth, he can call the porter, have a lamp removed and another lamp with a cord attached to the socket substituted and take his light to bed and read as long as he wishes; or by the same arrangement he can have his light hung against the side of the car and read in his seat. However, it will scarcely be necessary for any one to resort to this course while all the lights are on, as the illumination is equal to that of day-light.

The accumulators that hold the charge for each car consist of thirty cells, fifteen of which are in two boxes underneath the body of the car, one on each side. Johnson, Holland & Co., of Chicago, supplied the electrical equipment. They guaranteed that the charge would supply the lamps for ten hours, and the results show that their guarantee is ample. Each car has three sets of accumulators. While one set is in use, the second set is being charged in Chicago and the third set in New York. Immediately upon arrival at either city the accumulators that have been in use are removed and the newly charged set put in their place. In Chicago the change has to be very expeditiously made, as the cars can not be detained in the train-house, but must at once be taken to the yard. Recently the entire operation of changing the freshly-charged cells for those that had been in use was accomplished in fifteen minutes. The connections between the cells are automatic, and laborers can perform the work of changing as well as the most accomplished electricians.

Words of Greeting.

We understand that early in July the first number of the Western Electrician will be issued in Chicago. The editor and manager will be Mr. W. A. Kreidler, who is well known as the western representative of *The Electrical World*. There is little doubt that a live electrical paper will find plenty of elbow room in the west; and the present enterprise is certainly in good hands. We shall be glad to give our new contemporary a hearty welcome when it makes its appearance. —*The Electrical World*.

It is with pleasure that the kindness of these words is acknowledged. The spirit of friendship that dictated them is particularly gratifying, and the same courtesy that characterized the dealings of *The Electrical World* with the editor of the Western Electrician while the latter was in their employ as their western agent, marks the words quoted that welcome the birth of a contemporary devoted to the same interests. We believe with *The Electrical World* that there is plenty of room in the west—hence, the venture.

Our thanks are due to Mr. C. C. Haskins, western correspondent of *The Electrical Review*, for the following: "On the 2d of July the Western Electrician is expected to make its appearance here. Mr. W. A. Kreidler, until now the Chicago and western correspondent of a New York paper, is the principal mover in the new journal enterprise, and has severed his connection with the New York publication with this in view. Mr. Kreidler and his co-workers are jubilant over the prospects, and are thoroughly impressed with the belief that perfect success is assured for the new journal; and their friends, the electrical fraternity, will rejoice at the fulfillment of their hopes."

Electricity Applied to Air Brakes.

The report of the Brake committee to the Master Car Builders' association on the Burlington brake tests concludes as follows: While we are not prepared to make any definite recommendation at this writing as to what freight train brake should be generally adopted, our present information, derived from the recent tests, points to two conclusions:

1. That the best type of brake for long freight trains is one operated by air, and in which the valves are actuated by electricity.

2. That this type of brake possesses four distinct advantages:

(*a*). It stops the train in the shortest possible distance.

(*b*). It abolishes shocks and their attending damages to equipment.

(*c*). It releases instantaneously.

(*d*). It can be graduated perfectly.

The further question as to whether electricity is a sufficiently reliable element to use in freight train service is one that can only be determined by experiment, but we think the benefits derived from electricity are so manifest that the experiment is well worth trying.

In view of the foregoing and of the improvements that the buffer and atmospheric brakes are making, your committee recommends that the subject of automatic freight train brakes be continued for further investigation.

The lines, instruments, etc, of the Arkansas Telegraph company, operating between Little Rock and Pine Bluff and Hot Springs, have been sold, under an execution, to the St. Louis, Iron Mountain & Southern railroad company. This company formed the Little Rock, Hot Springs & Pine Bluff connection with the Baltimore & Ohio lines, and has been in operation nearly two years.

ELECTRIC LIGHTING.

Rochester, N. Y., has just entered into contracts with the three electric light companies for lighting the entire city by the electric light for five years. The Edison Electric Illuminating company, whose plant is run by steam, was awarded the contract for 700 or more incandescent lights of 20 candle-power, each to be placed and used in the kerosene lamp district on the west side of the river at the following rates: First year, four cents per lamp per night; second year, four and one-half cents; third year, four and three-fourths cents; fourth year, five and three-fourths cents; fifth year, six cents. The Rochester Electric Light company, using the United States system, and utilizing a fine water-power, received the contract for furnishing 100 or more 2,000 candle-power arc lights at the round rate of twenty-eight and one-half cents per light per night for the entire five years. The Brush Electric Light company, which is provided with a constant water-power of great magnitude, will furnish 567 arc lights of 2,000 candle-power each, at thirty cents each per night for the first two years, twenty-eight cents for the second two years, and twenty-seven cents for the fifth year. Without calculating on any increase in the number of lights, but simply as the contracts now stand, the Brush company will receive $175,411.75 for the five years, the Edison company $63,875.00, and the Rochester company $52,012 50. The Brush company, it should be stated, has had its plant in operation for some years, the Rochester company has but recently been put in first-class order, while the Edison company has not concluded its first year of existence.

Warsaw Electric company of Warsaw, Ill., are putting in a 45-light Brush dynamo and a 45 horse power Westinghouse standard engine.

The Archer Electric Light company of Wichita, Kan., early last month put in operation the Fort Wayne Jenney system of incandescent lights. The *Daily Eagle* of the 12th ultimo speaks in high terms of the system.

Last November, Charles J. Steinau, of Cincinnati, contracted with the Cincinnati Gas Light company to use gas for ten years for lighting a store building, agreeing to pay $1.30 per 1,000 cubic feet, this price to be reduced if council ordered a general reduction in price of gas throughout the city. Mr. Steinau, since making the contract, introduced electric lights and discontinued the use of gas. The gas company appealed to the courts to compel Mr. Steinau to discontinue the use of electric lights, and the circuit court has sustained the common pleas in granting an injunction restraining him from using the electric light during the life of his contract with the gas company. Mr. Steinau is in an unfortunate position, inasmuch as he cannot participate in the benefits of the electric light for nearly a decade, and by that time the steadily increasing popularity of the electric light will undoubtedly have placed it not only in every store building but also in every private residence.

The Springfield Electric Light company, of Springfield, Ill., have ordered an additional 35-light machine and lamps from the American Electric company.

A paper on the principal elements of danger in flour mills, recently read before the Association of British and Irish millers, refers to the danger of fire from unprotected lights, and says: "Naked lights have to some extent been replaced by incandescent electric lights, which are not only safe as regards exploding dry dust, and free from the various risks of gas, but have the advantage of reducing the general temperature of the mill. Too much stress cannot be laid upon the superiority of electric lighting."

The Pond Engineering company of St. Louis are erecting the complete steam plant for the electric light station now being put in by the Paris Gas and Electric Light company, Paris, Tex. The contract includes two 60 horse-power steel tubular boilers, one 60 horse-power Armington & Sims engine, Sheffield grates, Blake boiler feed pump, Korting injector, feed water heater, brick and pipe work, and belting—in fact, a first-class outfit, set up ready for service. The American system is to be used.

The mammoth Rialto building, Kansas City, Mo., is to be lighted throughout with incandescent electric lamps. The Pond Engineering company, St. Louis, have contracted to furnish and erect an Armington & Sims engine for driving the dynamos.

The Kansas City office of the Pond Engineering company has been awarded a contract for furnishing an Armington & Sims engine for driving the shops and an incandescent dynamo at the power station of the Grand avenue Cable Railway company. The Metropolitan Street Railway company of the same city have also placed an order for an Armington & Sims engine for the same purpose.

The Jenney Electric company of Indianapolis, Ind., are about to put a plant in the new Denison hotel in Indianapolis, made up altogether of large incandescent lamps, ranging from 200 to 400 candle-power each.

F. W. King, superintendent of lamps, says Baltimore *American*, has collected data from official sources in reference to the cost of electric lighting. Various matters, such as the number of lamps, the ownership of plant, candle-power, etc., must be taken into consideration in figuring up the cost in the various cities. The candle-power in all the cities is 2,000, except in Brooklyn, where it is 1,200. New York has a contract for one year with the Brush and United States companies, and has in use 711 lamps at 70 cents each per night. Philadelphia has 525 lamps, for which an average of 54 cents per night is paid under a one-year contract, and the Brush, United States, and Houston systems are used. Brooklyn has 995 lamps at a cost of 50 cents each (1,200 candle-power). The contract is for one year, and the Thomson-Houston system is used. Boston has 504 lamps at a cost of 65 cents each, furnished by the Brush, Western, and Thomson-Houston companies under a three-year contract, and the city owns the posts, extensions and hoods. Newark, N. J., has 150 lamps at a cost of 50 cents, furnished by the United States and Western companies under a three-year contract. Providence, R. I., has 175 lamps at a cost of 50 cents, furnished by the Western and Thomson-Houston companies under a one-year contract. Albany has 481 lamps at 50 cents each, furnished by the Brush company under a five-year contract, and owns the lamps, posts, poles and lanterns. Albany, Boston and Philadelphia, which pay 50 cents, 65 cents, and 54 cents, respectively, own more or less of the plant.

A suit was brought by the Brush Electric company against the Cleveland Electric Light company in the United States circuit court, June 8th, to secure damages for the alleged infringement of a patent. The officers of the defendant company are S. C. Smith, president, S. M. Strong, vice president, F. J. Stafford, secretary, treasurer and general manager. The bill of complaint states that on September 2d, 1879, Charles F. Brush was awarded letters patent for an improvement on electric arc lamps, and that the Cleveland Electric Light company have unlawfully made use of the invention. The Brush company seek an injunction, the destruction of lamps now held by the defendants, and a suitable award of damages. —Cleveland *Leader and Herald.*

Treviso, a small town of 18,000 inhabitants, north of Venice, has adopted the electric light and is burning 600 lamps, some of 32, some of 16, and some of 10 candle-power.

The Chicago, Burlington & Quincy railroad company are talking of lighting some of their suburban trains by electricity stored in accumulators.

The experiment of lighting with electricity generated by car-wheels is being tried by the Connecticut Valley railroad.

At the recent trial of the "boodlers" McGarigle and McDonald in Chicago, the jury rebelled at gas light during the evening sessions, made a demand for electric lights and got them.

THE ELECTRIC MOTOR.

The first application of electricity as a motor for running street-cars in St. Louis was made on the 25th ult. on the Washington avenue line. The test was considered highly successful, and as soon as the necessary machinery and apparatus can be attached to the cars the entire road will be run by electricity. The motor used is known as the Julien system.

On the 19th ult. the Detroit *Tribune* printed a sixteen-page paper on a web perfecting press with an electric motor, put in by the Sprague Electric Railway & Motor company, furnishing the power. The motor is of the ten-horse power size and supplanted an engine of nominally double the power. The proprietors express great satisfaction with the performance of the motor.

The Union street railway, St. Joseph, Mo., has adopted the Sprague electric railway system, and it is expected that the road will be ready for operation in a few days. The steam-plant is being erected by the Pond Engineering company, St. Louis and Kansas City, who are furnishing the Armington & Sims engine, Lowe feed-water heater, Blake steam-pumps, valves, belting, etc.

THE TELEPHONE.

The annual report of the Great Southern Telephone & Telegraph Co. just issued, shows that for the fiscal year closing March 31, 1887, the gross earnings were $129,515.55 and the gross expenses $94,518.66, leaving the net profits $59,152.03. The present number of exchanges is 12, and the number of subscribers 1815. The number of miles of toll lines is 1053 and the number of toll stations 143. The district of the company comprises portions of Louisiana and Mississippi.

Last November the toll system was presented the subscribers of the Rochester, N. Y., telephone exchange for adoption. The argument of the company was that in the face of the indiscriminate use of the telephone by non-subscribers and the fact that a business house using the telephone almost continuously throughout the day paid no more for the service than a house using its instrument only a dozen times a day, the toll system was the only fair and just basis. The subscribers, while in many cases acknowledging the soundness and justice of the argument, insisted that the proposed rates were exorbitant. An association was formed by the subscribers to resist to resist the introduction of the system and nearly all cut out their telephones. The difficulty is still unsettled. Meanwhile the Writing Telegraph company has established an exchange and now has about twenty-five subscribers.

Thus far, according to a dispatch in the Cleveland *Leader*, the Pan-Electric suits have cost the government nearly $150,000. The six attorneys engaged by the government have received about $42,000.

A special dispatch to a Chicago paper from Indianapolis says: "Ever since the telephone bill became a law the company has been vainly endeavoring to fix upon some scheme to avoid it. It has procured the following petition: 'We, the undersigned citizens of Indianapolis, recognizing the unsatisfactory condition of the telephone service in this city, and the claim of the Central Union company that they can not do business under the law without losing money, hereby propose to said company the following basis of charges to be paid by us. We will pay said company the sum of $18 per annum, payable semi-annually, in advance, and will also pay in addition thereto the rates of toll heretofore charged by said company in this city.'" F. G. Beach, superintendent of the Central Union Telephone company, unequivocally pronounces the statement a falsehood. He states that the originator of the petition is the inventor or owner of a registering device to be attached to a telephone and which records automatically the number of calls, the intent being to prevent any discrepancies under a toll system between the number of messages recorded against a subscriber in the exchange and the number that the subscriber either records against himself or thinks ought to be recorded against him. The telephone company has not adopted the registering device and undoubtedly will not.

Two years ago the state of Indiana by law fixed the annual rental of a single telephone at $36 per year. An effort is now being made to have an ordinance passed by the Chicago common council to tax each telephone in use in the city $25 a year. The Indiana legislature and the Chicago board of aldermen seem to take somewhat diverse views of the telephone.

A telephone service has been installed between the Bourse at Paris and the central telephone office in Havre, the charge for five minutes' conversation being fixed at 1fr. The working of the line is perfectly satisfactory.

THE TELEGRAPH.

A local order of railway telegraphers has been organized at Indianapolis, with twenty charter members and the following officers: Chief telegrapher, I. S. Pierce; assistant chief telegrapher, G. W. Martindale; secretary-treasurer, J. F. Kennedy; senior telegrapher, J. P. Collins; junior telegrapher, J. H. Bowers; inside sentinel, C. F. Hageman; outside sentinel, T. H. Farrell; past chief telegrapher, H. G. Henze; executive committee, J. R. Barnett, J. M. Sanders and A. J. Wheeler.

There are about 20,000 miles of telegraph and telephone wires in New York city. Of this number the Western Union Telegraph company operates and controls more than 5,000 miles, 500 miles of which are already placed in conduits underground. The same company operates over 430,000 miles all told. Its wires if stretched in one continuous line would go around the globe nearly eighteen times, and they would reach from the earth to the moon and almost back again.

The death of Freeman Clarke, of Rochester, N. Y., occurred June 24th at the age of seventy-five years. He was a member of the thirty-eighth congress in 1862 and comptroller of currency in 1865. For many years previous to his death, Mr. Clarke had led a quiet, uneventful life, rarely, if ever, appearing on any public occasion, but his death recalls the fact that he was contemporary with that coterie of organizers of the Western Union Telegraph company, of whom but a few are left.

NEW ENTERPRISES.

The First National Bank of Ottawa, Kansas, are about to erect a new building.

J. W. Aylor of Webb city, will erect an Opera House block at Carthage, Mo.

Hamilton & Steen of Kansas City, Mo., are about to expend $100,000 on a grand stand and club house.

The Southern Oil Co. of Little Rock, Ark., will erect a new oil mill at Argenta, Ark., and will put in the electric light. The plans call for an expenditure of about $100,000.

N. N. E. Wood of Sioux City, Ia., will put up an office block to cost $25,000.

The cost of the new court house at Evansville, Ind., will be about $350,000. County commissioner Christ. Wunderlich is chairman of the committee.

L. R. Curtis of Mendota, Ill., is to put in a 500-light incandescent plant.

M. Bowen is president and R. L. Curtis secretary of a stock company formed to start an organ factory at Mendota, Ill. The outlay will be $100,000; $60,000 of the stock has been subscribed.

A new hotel is to be erected at Mason City, Iowa, by H. A. Dyer. He proposes to expend about $20,000 on it.

William Gordon is owner, and E. W. Loft architect, of a new apartment house to cost $75,000, to be erected at Sioux City, Iowa.

The Galesburg Illuminating Co. of Galesburg, Ill., will enlarge their present plant.

McCormick Reaper Works of Chicago, Ill., expect to expend about $100,000 on their plant at Aurora, Ill.

Aurora Cotton Mills of Aurora, Ill., will put in the electric light.

Wm. Donaldson & Co. of Duluth, Minn., will erect a business block to be used as a dry goods store. The cost will be $25,000. McMillan & Stebbins are the architects.

J. C Banaos of Minneapolis, Minn., is building a handsome residence and will fit it up with electric bells. George Hulm, druggist of the same place, is building a $4,000 residence, and will also put in electric bells.

A new factory is being built in Cedar Rapids, Iowa, by a stock company of which Hon. S. L. Dows and H. B. Souther are the principal shareholders. It will cost $50,000.

Spalding Hotel Co. of Duluth, Minn., are putting up a seven story hotel, to be named Hotel Duluth. It will cost $300,000 and in all respects promises to be a fine building. It will be provided with electric lights and electrical apparatus throughout. The Duluth National Bank will expend $150,000 on a six story building.

At Minneapolis, Minn., Albert Johnson is erecting a seven story business block at a cost of $75,000. It will be fitted with electric appliances.

D. M. Bell is president of the Electric Light and Power Co. of Lyons, Kansas, who are ready to put in an electric light plant. W. T. Nichols of the same place, will build a new brick building with all the modern improvements.

Norfolk Opera House Co. of Norfolk, Nebraska, are building a new opera house and stores, to cost $45,000.

The Stillwater Electric Co. of Stillwater, Minn., R. H. Bronson, secretary and treasurer, propose to expend about $5,000 on their plant.

C. C. Miller & Co., Larned, Kan., are erecting a two-story building for commercial purposes at a cost of $35,000.

The new court house of Coldwater, Mich., M. H. Parker, architect, will be fitted with electric appliances. The estimated cost of the building is $40,000.

G. S. Mayhew, 1530 East 18th street, Minneapolis, Minn., is about to erect five frame dwellings at a cost of $2,500 each. They will be fitted with electric bells.

A new hotel to cost $35,000 is going up at Keokuk, Iowa, Keokuk Hotel Co. owners; electric appliances will be put in.

The Franciscan Sisters of Keokuk, Iowa, are erecting a new hospital at a cost of $15,000, from plans made by Architect Sunderland of Burlington, Iowa. The building will be provided with electric bells.

The Paola Electric Light and Power Co., of Paola, Kan., and The Hays City Electric Light Co. of Hays City, Kan., are organizations of recent incorporation.

Miscellaneous Notes.

Boston is soon to test a new electric apparatus on the fire engines of the department, says the *Fireman's Herald*. The invention is a system of electric signaling applied to the hose in such a manner that wherever the linemen may be they are in instantaneous communication with the engineer in charge of the engine. The wires are laid inside each length of hose and the brass couplings of each length are furnished with an automatic electric coupling, so that if a piece of hose is damaged another may be quickly put in its place without deranging the electric circuit. The strain on the hose and engine by the use of the shut-off nozzle and relief valve now so extensively employed, is done away with, and the stream is controlled entirely by the engineer at the engine

We are in receipt of a copy of the handsome illustrated catalogue of steam and hydraulic machinery just issued by the Pond Engineering company, St Louis and Kansas City. The catalogue contains much valuable information for steam users, among other things useful data on hydraulics, operation of pumping machinery, temperature and weight of steam at various pressures, mean effective pressure in steam-engine cylinders, heating feed water, safe working-pressures for boilers, dimensions of standard chimneys for all horse-powers; proportions, heating-surface and horse-power of horizontal boilers, the efficiency of fire-streams, etc. This company makes a specialty of steam-plants for electrical duty. A copy of the catalogue will be mailed to interested persons on application, and makes a desirable addition to the library of any steam-plant.

The city council of Chicago are considering the advisability of lighting the principal streets with electricity. To do this it would require about fifteen electric plants, which could be put in at a cost of $47,000 apiece. This plan hinges upon that for lighting the river by electricity, as noted elsewhere.

The New York Exhibition.

The New York Electrical society will give an electrical exhibition in the large exhibition building of the American Institute in that city, commencing September 28th next, and ending December 3d. The exhibition will include all that relates to the science and application of electricity in its broadest sense. The American Institute and the American Institute of Electrical Engineers have assured the society of their hearty coöperation.

Business Mention.

The Western Electric Company of Chicago and New York have just completed an order for about eight miles of underground cable for Sixth avenue, New York, for the Metropolitan Telegraph and Telephone Co. of that city; and have in hand orders for a cable containing from 25 to 150 wires, an aggregate of about 250 miles of wire, which is being laid in West Madison street, Chicago, between Halsted street and Ashland avenue by the Chicago Telephone Co.; about three miles of 50-wire underground cable for the Alleghany City, Penn., Telephone Co.; about 5000 feet of 100-wire aerial cable for the Missouri and Kansas Telephone Co.; and half a mile of cable for the Baltimore & Ohio Telegraph Co. to extend their underground system in Chicago. They are also at work in the following orders: A 40-light dynamo for the Red Cloud Electric Light Co., Red Cloud, Neb.; a large multiple switch board for Memphis, Tenn.; and an additional 35-light outfit for the St. Louis Western Electric Light & Power Co.

The Midland Electric company of Omaha, Neb., write very encouragingly of their business prospects for the present year. Every indication is that the volume of their business will be fully three times that of the aggregate amount of last year. Their annunciator business is on the rapid increase. They have lately put in hotel annunciators at Norfolk, Wymore, Kearney, Grand Island and Lincoln, Nebraska, and Rapid City, Dak., in addition to their large business in Omaha. They are the licensees under the patents belonging to the Viaduct Manufacturing company for the introduction of the McCulloh district telegraph and fire alarm system in the states of Nebraska, Wisconsin, Kansas, Colorado, Oregon, Iowa, except Des Moines; Minnesota, except St. Paul and Minneapolis; Missouri, except St. Louis; and in the territories of Dakota, Wyoming, Utah, Montana and Washington.

Leonard & Izard of Chicago for the Edison company are installing a central station plant of 500 lights at Winona, Min.; a street lighting system of 72 thirty-two candle power lights at Olney, Ill.; a plant of 30 lights for the Muscatine Oatmeal Co., at Muscatine, Ia.; an enlargement of 50 lights of the plant of the Commercial Safety Deposit Company of Chicago; a central station plant of 500 lights for the Cascade Milling Co., of Sioux Falls, D. T.; a plant of 200 lights for the South Dakota penitentiary at Sioux Falls, D. T.; a central station of 500 lights at Paris, Ill.; a plant of 37 lights for Frank Glover, Clark street, Chicago; a plant of 80 lights for Lansing & Sickler, Clark street, Chicago; a plant of 600 lights for the Shattuc schools, Faribault, Minn.; a plant of 240 lights for the Anglo-American Provision company, South Omaha, and an enlargement of 300 lights for the "The Fair," Chicago. A handsome contract taken by the same firm is for a plant of 4000 lights for "The Rookery," a magnificent commercial building on Adams street, Chicago. They are also wiring the Layton Art Gallery at Milwaukee, Wis., for 200 lights.

There are over 100,000 horses used in hauling street cars in the United States. Chicago has 8,625; Cincinnati, 2,175 and St. Louis, 2,815. Five years is more than the average useful life of a horse for street car purposes. The success of the Van Depoele system of propelling street cars by electricity has convinced street car men that the horses must go, more especially since it has been thoroughly demonstrated that cars can be run by electricity under this system for one-half the cost of running by horses. The Van Depoele Electric Manufacturing Co. of Chicago, are crowding their shops to fill orders.

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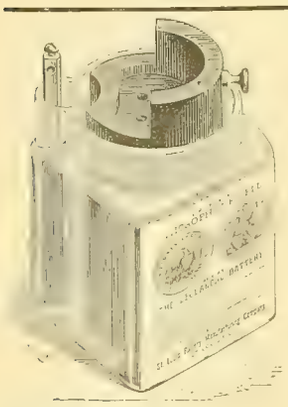

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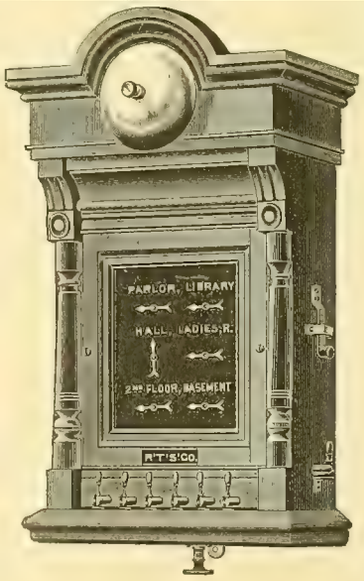

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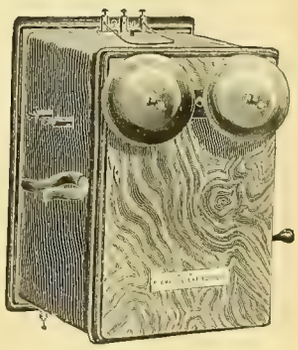

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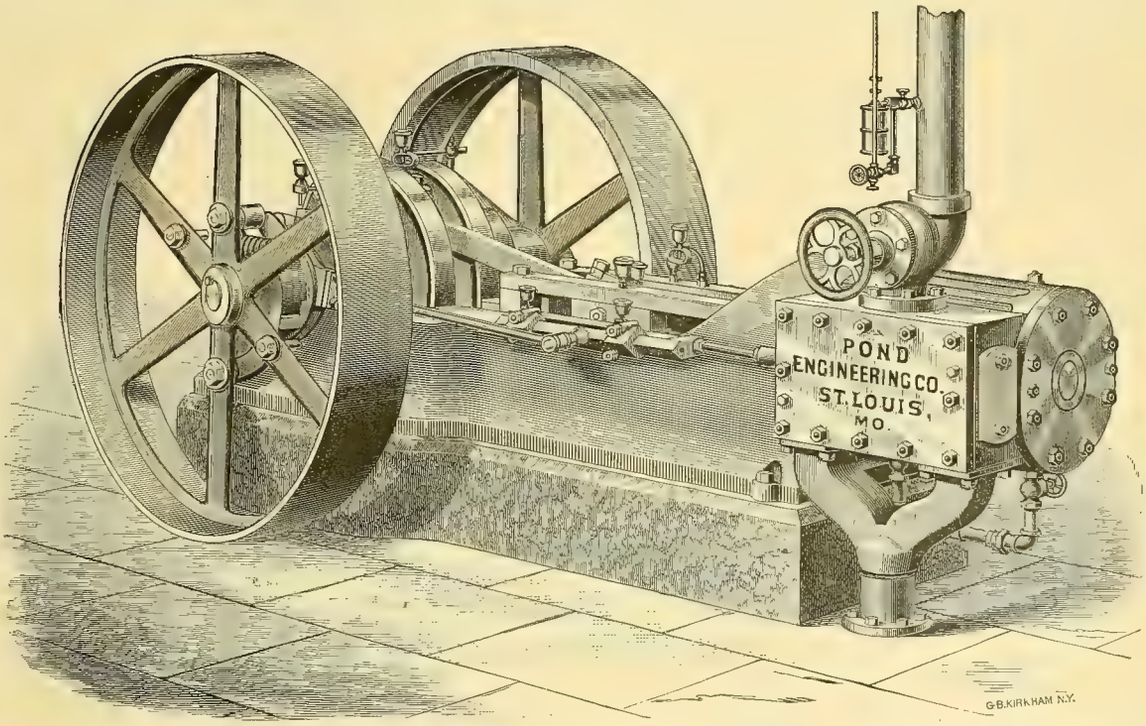

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The "Jarvis Patent Furnace" a Specialty.

Burns Slack, Screenings, Coke, Breeze, etc. Correspondence solicited. Circulars, Catalogues, and general information furnished on application.

CHICAGO, 81 LAKE STREET.

BOSTON: No. 61 Oliver Street.

H. A. GLASIER, *Manager Western Department.*

NEW YORK: No. 108 Liberty Street.

The United States Electric Lighting Co.

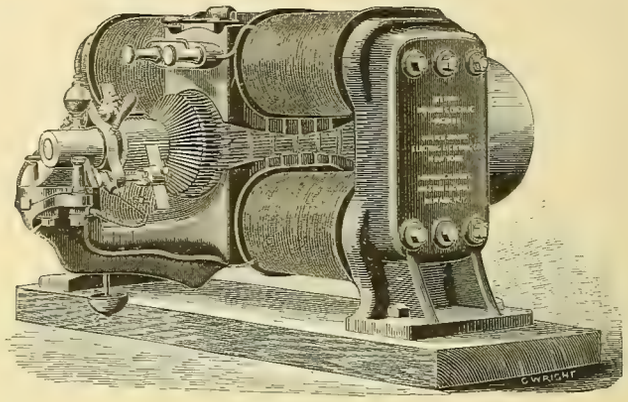
MANUFACTURERS OF

Incandescent and Arc Light Apparatus.

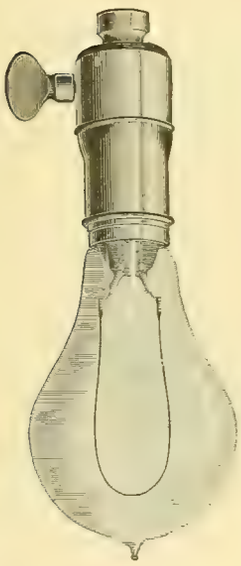
Claiming Superiority over other Systems

BECAUSE OF

Economy of Power.
Mechanical Design and Workmanship.
Perfection of Automatic Regulation.
Durability of Lamps.
Absence of Discoloration of the Lamp Globes.
Precision and Reliability of Measuring Instruments.
Completeness of Detail.



United • States • Long • Distance • Incandescent • Lighting.

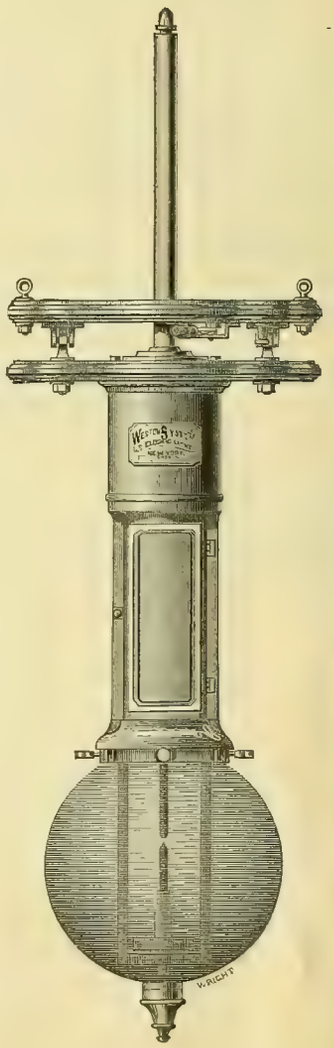


The only system offering reasonably low cost for main conductors combined with economy in operation, that has been subjected to a commercial test for any length of time.

ITS CLAIMS ARE

GREAT SIMPLICITY.
UNEQUALLED ECONOMY OF OPERATION.
UNEQUALLED ECONOMY IN COST OF MAINS.
THAT IT CAN BE DISTRIBUTED MORE WIDELY.
Greater COMMERCIAL SUCCESS than any other System Tested.

SEND FOR CATALOGUE AND TESTIMONIALS.



Compare our guarantees of the following SIX most important points in incandescent lighting with the guarantees of any other Company.

1st.	Number of 16 Candle Power Lamps to the Horse Power,	10
2nd.	" " 20 " " " " " "	8
3rd.	Life " 16 " " " guaranteed,	600 hours.
4th.	" " 20 " " " "	1000 "
5th.	Percentage of discoloration of lamps at or near end of guaranteed life,	inappreciable.
6th.	Self Regulation of Dynamos to insure even burning of Lamps,	yes.

C. C. WARREN,

MANAGER WESTERN DEPARTMENT.

216 La Salle Street, CHICAGO.

Territory:—Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Arkansas, Kansas, Nebraska, Colorado, Dakota, Idaho, Montana, Utah, New Mexico, Texas, etc.

GENERAL OFFICES: **EQUITABLE BUILDING, 120 BROADWAY, NEW YORK.**

JAMES A. SLEEPER, President.
W. A. STILES, Secretary and Treasurer.

AARON K. STILES, Manager.
C. J. VAN DEPOELE, Electrician.

THE

Van Depoele Electric Manufacturing Co.

OF CHICAGO, ILL., U. S. A.

OWNERS OF THE PATENTS AND INVENTIONS OF CHAS. J. VAN DEPOELE.

FOR

ELECTRIC RAILWAY APPARATUS,

Electric Arc Light Dynamos and Lamps.

CONSTANT SPEED STATIONARY ELECTRIC MOTORS, ETC.

OUR

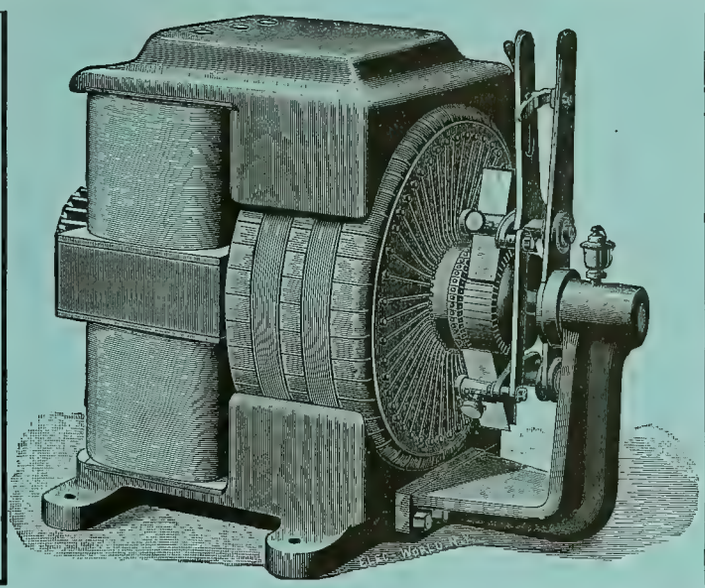
Electric Light

UNEQUALED.

The Only Perfect Double-Lamp.

THOUSANDS IN USE.

Guaranteed equal to any in every respect.



OUR

Electric Railway

SYSTEM

PROTECTED BY

BROAD PATENTS.

The Overhead Wire and Underground Conduit Systems Fully Protected.

Van Depoele Electric Railways

ARE IN OPERATION AT

Appleton, Wis., Scranton, Pa., Montgomery, Ala., Detroit and Port Huron, Mich., Windsor, Ont., Binghamton, N. Y., and Lima, O., and are being constructed at Ansonia, Ct., and Brooklyn, N. Y.

ESTIMATES AND CATALOGUES SENT ON APPLICATION.

VAN DEPOELE ELECTRIC LIGHTS

Are in use everywhere and are daily growing in popularity.

WRITE FOR ILLUSTRATED ELECTRIC LIGHT CATALOGUE.

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15, 17, 19 & 21 No. Clinton Street,

NEW YORK OFFICE:
20, 221 & 222, No. 45 BROADWAY.

CHICAGO, ILL., U. S. A.

OFFICERS:

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P. A. RANDALL, V. Prest. R. T. McDONALD, Treas. & Gen'l Manager.

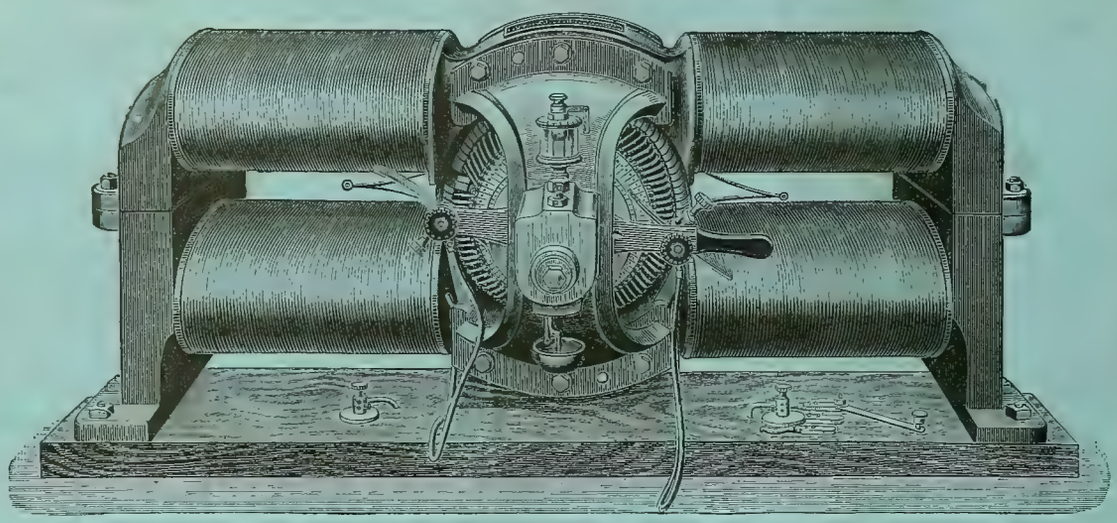
DIRECTOTS:

H. G. OLDS. JOHN H. BARR. P. A. RANDALL.
M. W. SIMONS. R. T. McDONALD.

Fort Wayne "Jenney" Electric Light Co.

SOLE OWNERS AND MANUFACTURERS OF THE

Main Office and Works:
Broadway and P. Ft. W. & C. Ry.
FORT WAYNE, IND., U. S. A.



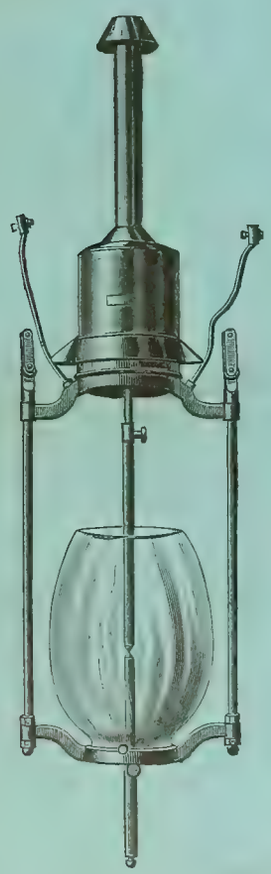
Branch Office:
115-117 Monroe Street, Chicago.
W. J. BUCKLEY, Manager.

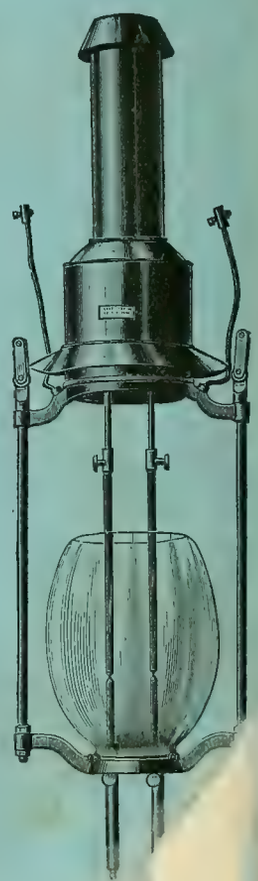
J. A. Jenney Dynamo-Electric Machines

—AND THE—

Perfectly Automatic and Self-Regulating

JENNEY ARC LIGHT





The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

ONLY GOLD MEDAL

At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

This system HAS NO EQUAL for SIMPLICITY, DURABILITY and STRENGTH OF LIGHT.

—ALSO—

COMPLETE INCANDESCENT SYSTEM.

DYNAMO: PERFECTLY AUTOMATIC, SHUNT WOUND, REQUIRING NO RESISTANCE for varia

LAMP: NEW FILAMENT, NEW PRINCIPLE of Construction, REMARKABLE LENGTH OF LIF CANDLE POWER, will not deposit carbon on inner surface of bulb.

The filament is as pliable as a piece of thread and is not made brittle by the action of the current.

Complete System of Fixtures and Attachments, also full line of Electoliers, Combination Fixtures and Shades.

We are in the market for Large Incandescent Contracts.

ELECTRIC MOTORS

We have the Only Perfect Working Headlight for Steamboats, with Focusing Reflector. F application.

Western Electrician

EVERY SATURDAY.

Vol. I. CHICAGO, JULY 9, 1887. No. 2.

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THE UNITED CARBON COMPANIES.

THIS ORGANIZATION INCLUDES ALL THE OLD AND LEADING MANUFACTURERS OF

Carbon Points and Plates

IN THE UNITED STATES.

With this United Knowledge and Experience we are enabled to furnish SUPERIOR CARBON POINTS, adapted to the different systems, at Fair and Just Prices to the Consumers and Manufacturers.

Orders promptly and carefully executed.

THE UNITED CARBON COMPANIES,

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PAYNE AUTOMATIC ENGINE.

B. W. PAYNE & SONS, MANUFACTURERS, ELMIRA, NEW YORK.

BUILDERS OF

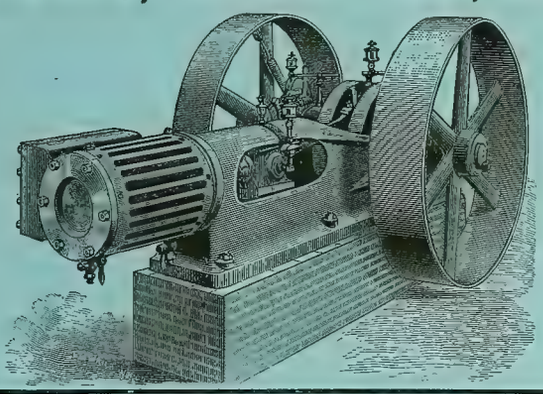
Single Valve and Corliss Valve

ENGINES.

SELF CONTAINED AND SINGLE CRANK

ENGINES

Specially Adapted for Electric Lighting.



WESTERN DEPARTMENT:

No. 10 S. Canal St.

CHICAGO.

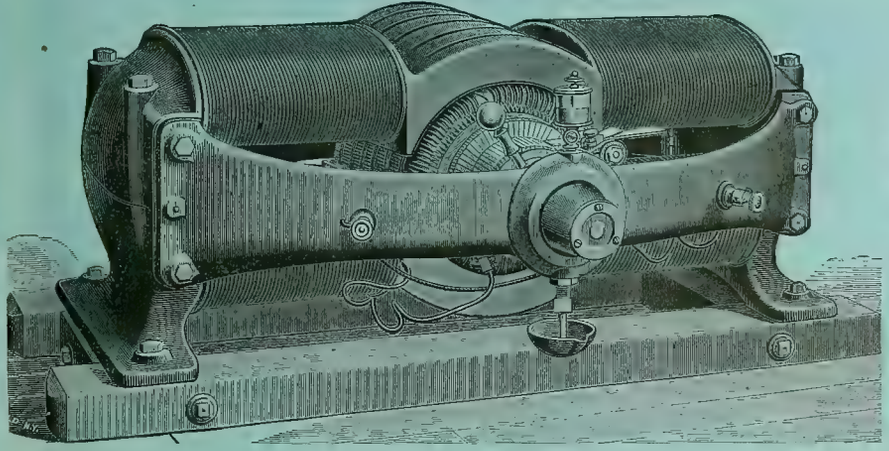
H. S. WALKER, MANAGER.

TELEPHONE 4024.

DANIEL W. MARMON, President. ADDISON H. NORDYKE, Vice-President. CHARLES D. JENNEY, Electrician. BRAINARD RORISON, Secretary. AMOS K. HOLLOWELL, Treasurer

JENNEY ELECTRIC COMPANY,

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Arc-Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

Cor. Kentucky Ave. and Morris St. Indianapolis, Ind.

The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

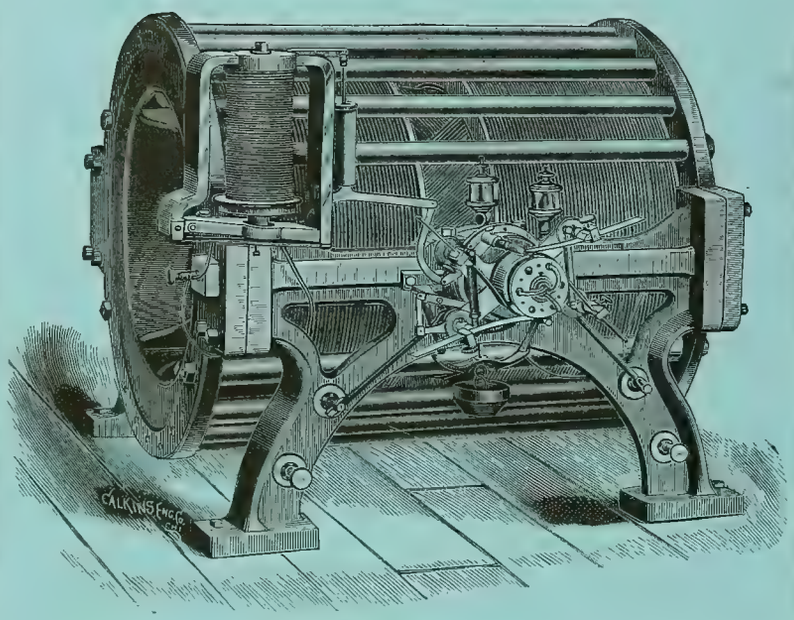
OF

Electric Arc-Lighting

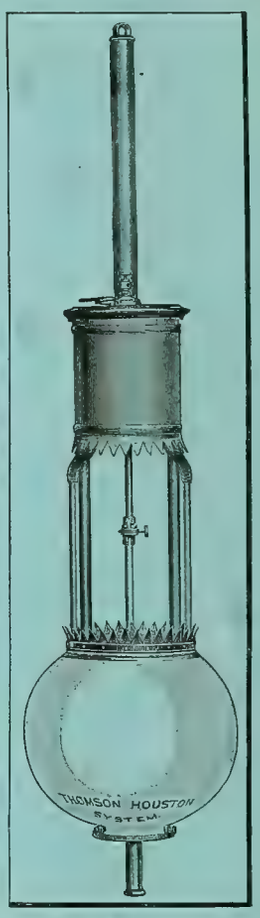
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

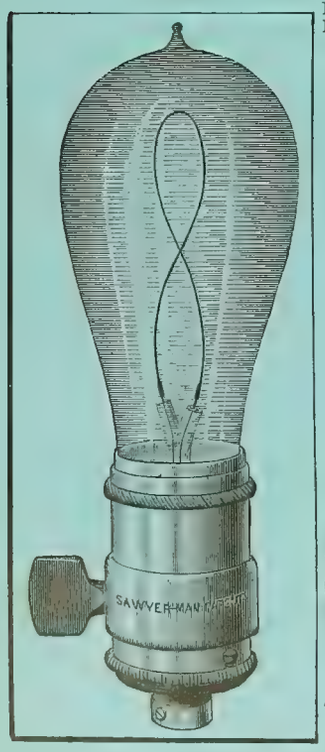


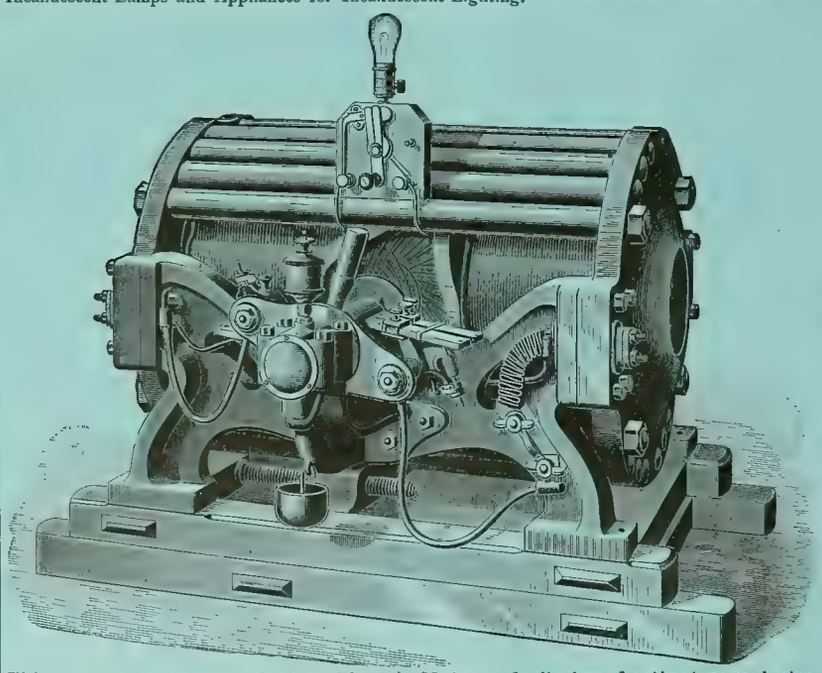
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT **LONG DISTANCE INCANDESCENT LIGHTING.**

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

COMBINATION

OF

Gas and Electric Light Interests

THE AMERICAN SYSTEM THE PIONEER OF THE NEW DEPARTURE

ELECTRIC LIGHTING AS DEMONSTRATED BY THE

American Electric Manufg. Co.

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Metropolitan Telephone Building, 18 Cortlandt Street, New York.

OFFICERS:

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L. M. BATES, Vice-President.
WILLIAM A. STEDMAN, Secretary and Treasurer.
JAMES J. WOOD, Electrician.

GENERAL AGENCIES:

AMERICAN ELECTRIC CONSTRUCTION CO., 146 Broadway, New York, New York State.

ST. PAUL GAS COMPANY, St. Paul, Minn., State of Minnesota.

CITIZENS' GAS LIGHT CO., Jacksonville, Fla., State of Florida.

SOWDON, ELDER & WRIGHT, 131 Devonshire St., Boston, New England States (except Connecticut).

PITTSBURGH ELECTRIC CO., EUGENE INGOLD, General Manager, 213 Wood St., Pittsburgh, Pa., Western Pennsylvania, Ohio, Kentucky and West Virginia.

J. M. CHIPMAN, 19 N. Pennsylvania St., Indianapolis, Ind., State of Indiana.

MARKLE ENGINEERING COMPANY, Detroit, Mich., State of Michigan.

This company has challenged all other systems to a competitive test of merit without response.

For completeness and simplicity of construction, durability and economy in operation, steadiness and quality of light produced, and perfection in automatic regulation, **THE AMERICAN SYSTEM HAS NO EQUAL.**

The Wood Automatic Regulator is entirely original, absolutely perfect in operation, and is the only perfect automatic current regulator ever invented, the pretensions of rival companies to the contrary notwithstanding.

It still invites comparison, and stands ready to meet any known system of Electric Arc Lighting in open, fair competitive tests, upon all points of superiority claimed for its apparatus whenever and wherever a sale is guaranteed to the winner.

POINTS OF EXCELLENCE:

The Wood Automatic Regulator is the only known invention that is perfect in its action for regulating the lamps better on long and short circuits.

It saves oil and commutator brushes.

The American system needs less care, and is run at much less expense than any other system.

Its apparatus occupies less space, weighs less, and requires less motive power for carrying any given number of lights than any other.

Its lights are steadier, and it requires less skill than any other to operate its apparatus.

The American system guarantees absolute safety of armatures from burning. This no other company can do, and it is this burning out of armatures in other systems that makes maintenance so expensive.

The American Company stands pledged to make good all their claims to any one desiring an Electric Plant of any kind.

ITS ALLIANCE WITH THE GAS COMPANIES. A new element of enormous power is now coming into the company's concerns The gas interests of the country have been converted to the commercial value of electric lighting as a business enterprise, the particular value of the system owned by this company, and its strong business alliance with the gas property of this company, is worthy of serious consideration of all purchasers of Electric Light Apparatus.

ADDRESS ALL COMMUNICATIONS TO

AMERICAN ELECTRIC MANUFACTURING CO.,

Metropolitan Telephone Building, 18 Cortlandt Street, NEW YORK.

REYNOLDS' IMPROVED CORLISS.

THE IDEAL ENGINE FOR ELECTRIC LIGHT WORK.

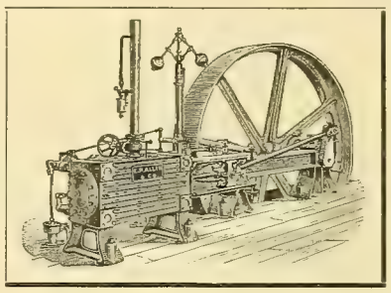
Unequaled for Close Regulation

—AND—

ECONOMY OF FUEL.

Write for our Catalogue and Circular giving List of Users.

—SOLE BUILDERS—



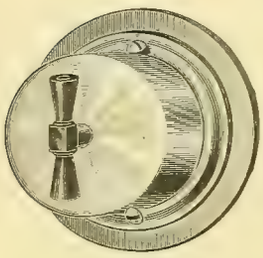
We refer to the following electric light plants now using the Reynolds' Corliss:
Brush Electric Light and Power Co., Cleveland, O.
Edison Electric Light and Power Co., Rockford, Ill.
Syracuse Electric Light Co., Syracuse, N. Y.
Louisiana Electric Light and Power Co., New Orleans, La., three engines.
Badger Illuminating Co., Milwaukee, Wis., two engines.
West Side Power Co., Minneapolis, Minn., four engines.
Louisville Electric Light Co., Louisville, Ky.
La Crosse Brush Electric Light and Power Co., La Crosse, Wis.
C., M. & St. P. R. R., Milwaukee, Wis.
Menominee Mining Co., Iron Mountain, Mich.
West Hotel, Minneapolis, Minn.
Plankinton House, Milwaukee, Wis.
N. W. Mutual Life Insurance Co., Milwaukee, Wis.
J. V. Farwell & Co., Chicago, Ill.
Chas. H. Slack, Chicago, Ill.
Mandel Brothers, Chicago, Ill.
C. Boetcher, Leadville, Col.
Omaha Thomson-Houston Electric Light Co., Omaha, Neb.
Thomson-Houston Electric Co., Racine, Wis.
Sioux Falls Electric Light and Power Co., Sioux Falls, Dakota.
Electric and Water Supply Co., Neillsville, Wis.

EDW. P. ALLIS & CO., RELIANCE WORKS, MILWAUKEE, WIS.

CHICAGO BRANCH: 48 South Canal Street.

FOREST CITY ELECTRIC WORKS,

MANUFACTURERS OF

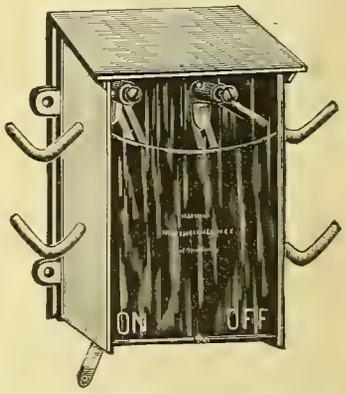


Cleveland's Electric Light Cut-outs,

GANG SWITCHES, FROM 5 TO 40 AMPORES.

Quick Make and Break Uncontrolled by the Handle.

Correspondence Solicited with Electric Light Companies.



W. B. CLEVELAND, Proprietor,

26 S. WATER STREET, CLEVELAND, O

GILES ANTI-MAGNETIC SHIELD FOR WATCHES.

Office of Van Depoele Electric M'fg. Co.
Chicago, Feb. 16, 1886.

Anti-Magnetic Shield & Watch Case Co.

Gentlemen:—Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good time-keeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is.

Very Respectfully,
CHAS. J. VAN DEPOELE,
Electrician, V. D. P. E. M. Co.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

WM. A. ANTHONY,
Prof. Phs. Dept., Cornell University.

The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers; it will render operative the fine adjustments and mechanisms which hitherto have been made almost *nil* and inoperative on account of their susceptibility to the all-pervading magnetic influence. AMERICAN WATCH CO.,
Waltham, Mass.

Sure protection from all Electrical and Magnetic disturbances
Send for descriptive circular.

GILES BROS. & CO., 103 State Street, CHICAGO.

NEW ✻ YORK ✻ SAFETY ✻ STEAM ✻ POWER ✻ CO.

BUILDERS OF HIGH GRADE SELF CONTAINED

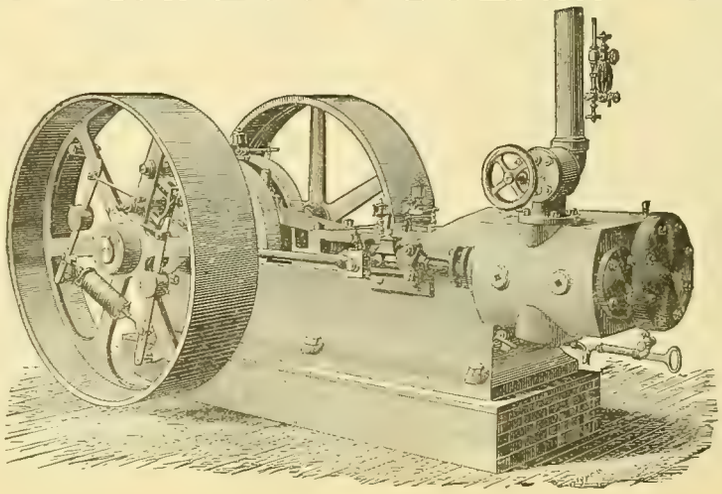
AUTOMATIC

Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC ✻ LIGHTS

And other duty requiring close regulation of speed.



ADVANTAGES:

Great strength without excessive weight,
Small space required.
Simplicity of construction.
Accessibility of all parts.

ESTIMATES CHEERFULLY FURNISHED.

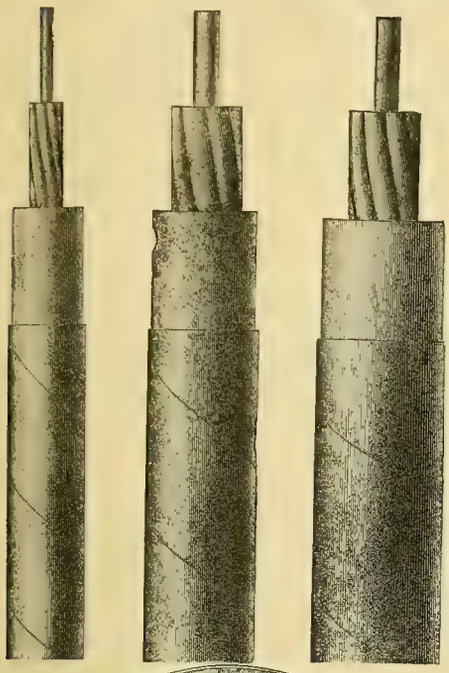
Western Office and Warerooms:

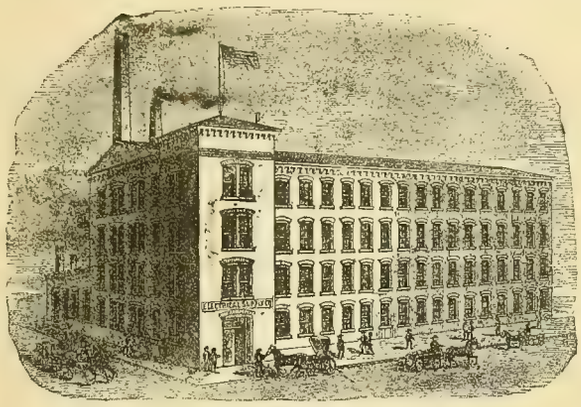
64 & 66 S. CANAL ST.,

CHICAGO., ILLS

WM. A. HAMMETT, Mgr.

The Electrical Supply Co.





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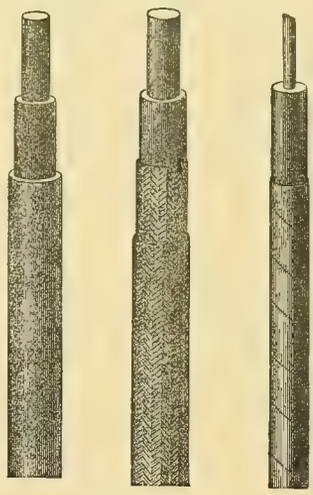

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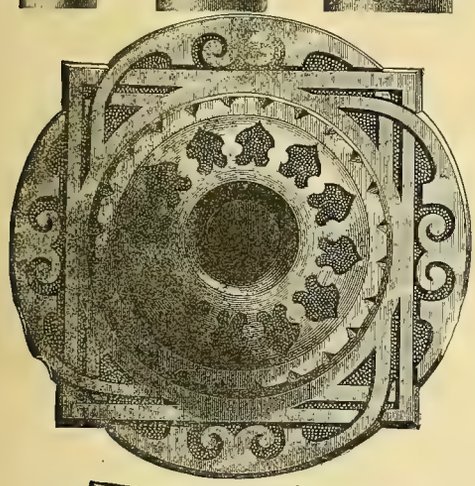

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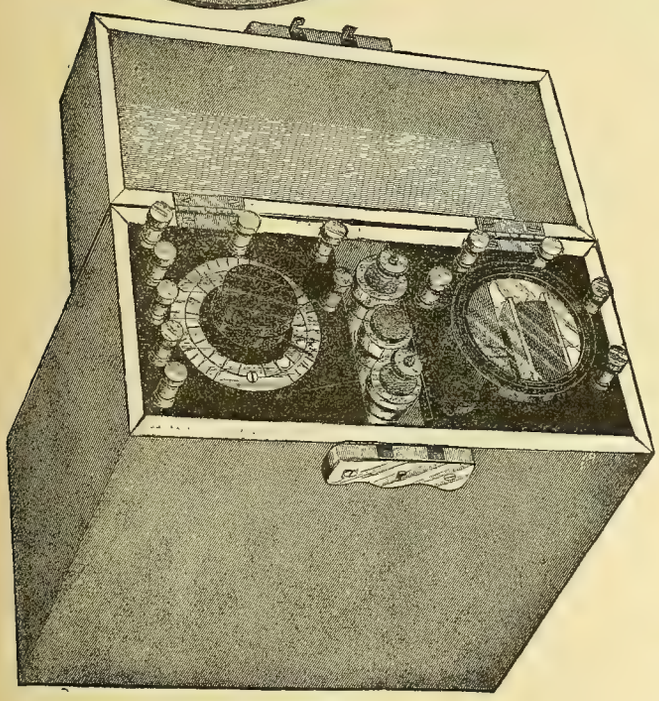

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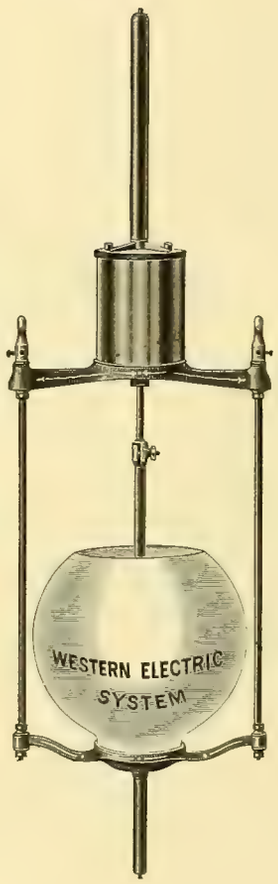

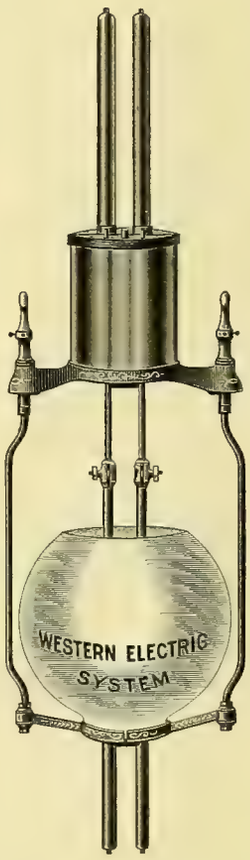

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Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, JULY 9, 1887. No. 2.

Fort Wayne Jenney Incandescent System.

The system of incandescent lighting manufactured by the Fort Wayne Jenney Electric Light Company, Fort Wayne, Ind., and illustrated herewith, has important advantages, and embodies some new features and ideas that are entirely original with this company. The system, in all its details, is constructed by expert electricians, and every attention paid to those essentials that make a system of electric lighting a commercial success. The great skill and almost numberless experiments of Professor Schaefer, the leading electrician of the company, have developed, first, a dynamo and lamp with an efficiency of 200 candle power per commercial horse power; secondly, a lamp whose average life is 1,800 hours; thirdly, a machine whose armature under a constant use runs perfectly cool, with brushes and commutator non-sparking and lasting for years; fourthly, dynamos with a potential such that incandescent lights can be run on a long distance circuit on No. 5 wire, with a loss of but 15 per cent. of the electrical energy in the circuit, and without the use of distributing boxes or any form of induction coils or cut outs.

Fig. 1 illustrates their latest style of incandescent dynamo, and a glance will show that it presents radical changes from the usual style of construction. Dynamos which have been constructed in the average form, with the usual disposition of iron, have not always proved to have a high efficiency on account of the high internal resistance of the armature and its weak field, causing a short life of commutators and brushes carrying a heavy spark and heating the armature, and a consequent increase over the necessary power. In the dynamo illustrated it will be noted that there is a large amount of iron so distributed as to force the highest magnetic field directly at the poles. The necessary iron is put in proper place, and a remarkable decrease of copper in proportion to the output has been accomplished. The strong field on these machines, the absence of Foucault currents and internal resistance, and the use of a copper commutator, allow the machine to run perfectly smooth for years. The armature core consists of iron disks, each insulated from the other, and becomes, therefore, magnetized in a right angle to the field. Any Foucault currents are thus prevented in the armature, and with a reasonable speed the armature can run constantly without becoming overheated. While a small amount of copper wire is used in these machines, and the armature runs very close between the pole pieces, the core itself is much nearer to the field, and represents a radical change from previous forms of construction.

The field has an entirely separate magnetic circuit, being independent of base or bearing, and furnishes a novel and better path for the lines of force in the pole pieces. The pole pieces are bored out in the shape of a spiral and the lines of force are throughout their entire surface, and the armatures thus become uniformly magnetized.

Incandescent lighting usually requires large conductors in lighting large areas, but the multiple series system of this company is capable of distributing lights to distances of miles. This is accomplished by using several machines for a multiple series system of varying potential. This company builds machines directly in proportion to each circuit, having the required electro-motive force according to circumstances and distances, and the machines are so constructed as to enable the connecting up of several machines in one circuit if desired.

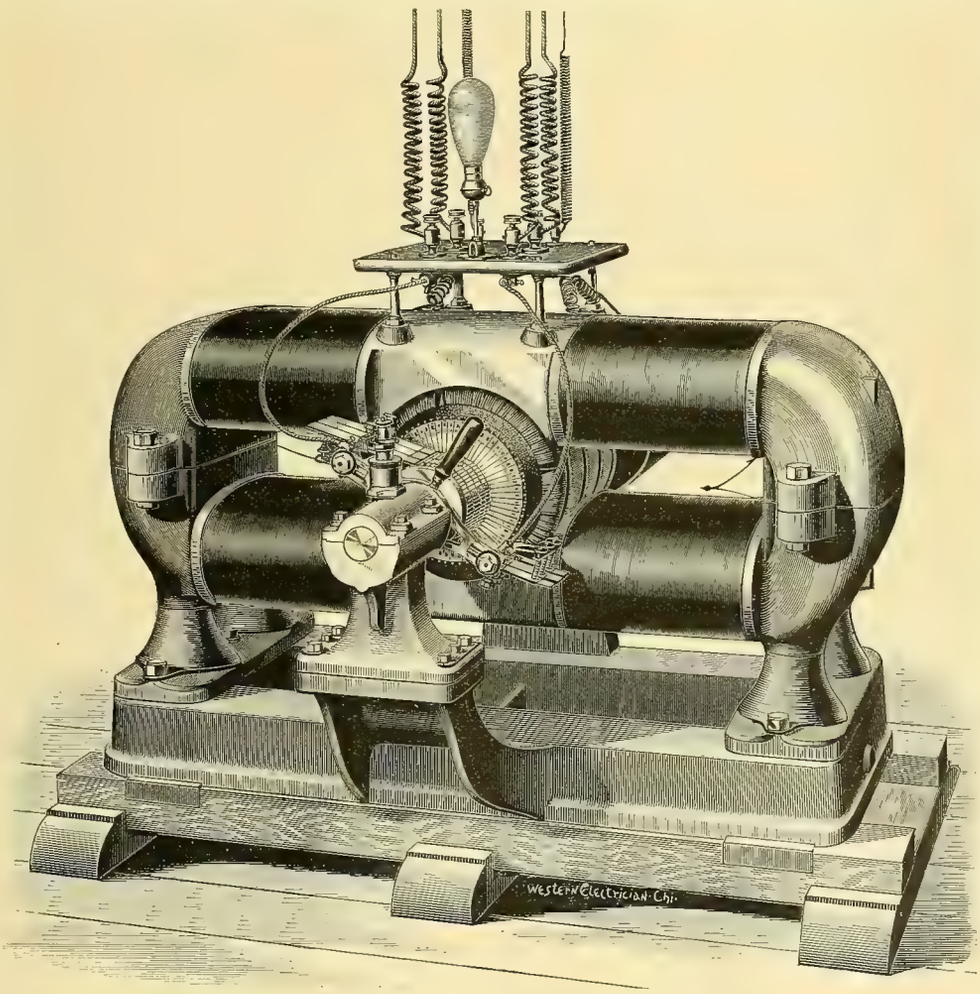

Fig. 1.

The lamp, which is the most important feature of any system, is manufactured by this company in a novel way. The material for the filament is suspended in a vacuum in which the carbonization takes place, and is shaped gradually during the process, thus making a filament as flexible as the finest steel wire, and insures a long life of the same. The finest filament desired can be manufactured in this manner to withstand a heavy current. After the filament is finished it is connected by a very ingenious apparatus with platinum wires, by means of metals melting at a low temperature, which joins both parts together. This process, in connection with a good vacuum, secures a highly efficient and long-lived lamp. The average candle power per commercial horse power is 200 candles, and with large lamps somewhat higher. These it is claimed are the best results ever obtained in the world. The company will guarantee ten sixteen-candle lamps per horse power even with a percentage of loss on the circuit. With larger lamps of 20 to 150 candle-power, they will guarantee a proportionately greater economy. The potential adopted for these lamps varies from 10 to 100 volts, according to circumstances and distances, and lamps are made from 10 to 150 candle power. The difficulty of obtaining a reliable and ornamental lamp socket has been overcome. The button is non-sparking, and a half turn separates the two parts of the socket, leaving the terminals entirely clear and ready for connection without the twisting of the wire,—a feature greatly appreciated by those versed in incandescent circuit construction. Any size of lamp can be attached and disconnected instantly by simply pushing it in or out.

Fig. 2 shows the ornamental appearance of the socket and the method of connection. Fig. 3 shows the lamp proper with the two terminals, but without the socket, and gives a fair idea of the manner of connection with the socket. Fig. 4 shows the lamp and socket complete.

The company have just completed a new factory, which is given over entirely to incandescent work, and have already received orders for eleven thousand lamps.

Carbons.

While the agitation in the carbon trade has continued lively during the week, there is nothing definite of any real interest to chronicle. There is plenty of talk of new combinations and deals, but no definite action has been taken. The matter grows more and more interesting, however, and developments are anxiously awaited by electric lighting men all over the country.

Electric Induction and Transformers for Electrical Distribution.*

At a recent meeting of the Institute there was shown a small model of a secondary induction coil which had been used a few days previously in the Institute lecture course. It was intended to show, in a crude way, the general principle of induction of one current by another; and particularly the induction or generation of a current of great quantity but low pressure, by means of one of small quantity but great pressure, this being the system introduced some years ago in Europe and lately brought into this country.

The system is used chiefly for incandescent electric lighting at a distance. The currents required for such lighting being of great quantity and of low tension, the transportation of such currents, by means of wires from the generating station to the consumer, is accompanied either by a great loss of power in the mains, or else it necessitates great expense in the first cost of the mains, which, when considering the interest and depreciation, is equivalent to a running expense of no small amount. In a system of induction coils, or "transformers," as they are generally termed, the energy is transported in the form of a small current of very high tension, in which form it may be led great distances along a comparatively small conductor, without any great loss, as the size of the wire is to a certain extent proportional to the current, but independent of the pressure. Such currents, which would be useless in this form for incandescent lighting, are converted or transformed at the consumers by means of these induction coils, into currents of great quantity by low tension.

These transformers are in principle mere Rhumkorff coils reversed, the primary current being of small quantity, and the secondary the great quantity. In detail, the apparatus shown differed greatly from the Rhumkorff coil, which, in the usual form, would be very inefficient. It consisted of a coil eight and one half inches mean diameter, of 127 turns of No. 16 B. & S. wire, weighing four pounds. The coil was taken just as it came off the reel, and bound with tape and shellacked canvas so as to have a circular cross-section. Next to this was placed a similar ring of a very thick wire, consisting of eight turns of No. 3 B. & S. wire, weighing 3 pounds 5 ounces, the diameter of this ring being the same. These two coils were then bound together and wrapped with eleven and one-half pounds of fine, soft iron bell hanger's wire.

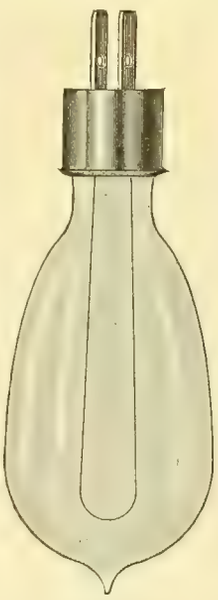

Fig. 3—Fort Wayne Jenney Incandescent System.

As the induction of currents in a neighboring wire takes place only with changes or reversals of the primary current, this primary current must either be intermittent or alternating. As the former is accompanied by destructive sparking, the latter is the only practical form of current to be used in practice.

When the apparatus was exhibited, an alternating current from a small Gerard machine was passed through a small german silver wire, No. 22, and into a fine wire coil. Upon connecting the coarse wire terminals with a similar german silver wire, it was instantly fused, showing that the same energy which passed through that fine wire in the form of a small current of high tension was transformed into one of such great quantity as to instantly fuse a similar wire. The same current was strong enough to fuse several strands of heavy iron wire, and to melt into a globule a three-inch wrought-iron nail.

Owing to the want of suitable measuring instruments, no quantitative tests could be made. As the only possible loss in such a coil is the heat developed in the copper wire due to its resistance, and the heat developed in the iron due to changes of magnetism and Foucault currents, it was quite correct to conclude that, as the coil kept quite cool, the efficiency was very high.

The generation of a current in such a coil may be readily explained on the same basis as the generation of currents in dynamo. In the latter

Fig. 2—Fort Wayne Jenney Incandescent System.

we know that when a wire passes through or "cuts," as it is termed, magnetic lines of force, a current will be generated in that wire. In the dynamos, the wire is moved mechanically nearer a magnet. In the transformer, as well as the Rhumkorff coil, it is the line of force or the magnetism which moves, as it might be called, across the wire. This may be understood as follows: Every current is encircled by numerous lines of magnetic force, as shown in the galvanometer and electro-magnet. These lines decrease in number as they are farther from the wire. A few years ago, the writer called attention to the fact that all the well-known laws of the mutual action and induction between currents could be explained by their lines of force. The attraction and repulsion of like and unlike currents could be explained by the attraction and repulsion of these invisible lines of force. The induction of a current in a wire, which was moved toward or away from a current, was explained by the cutting of the lines of force around the current by the moving wire. When a current is started in a wire, the lines of force, being proportioned in number to the current, will at first be very small circles around the wire, and as the current increases, these circles will grow larger; they may be said to be similar to the circular ripples produced on the surface of a still pond when a stone is thrown into the water. It is evident that a wire lying parallel to the first, and near to it, will be cut by these emanated lines of force, and, therefore, a current will be induced in it. From the laws of induction and of cutting lines of force, the direction of the induced current can be shown to be that actually observed. Similarly when the current was stopped, these lines of force came together again like a stretched rubber ring, and thereby cut the neighboring wires again, but in the opposite direction, thus inducing a current in the opposite direction. By thus considering the mutual action of currents as being merely the well-known action of the lines of force encircling the currents, the induction of currents in the Rhumkorff coil was readily explained without the use of Ampère's laws of the mutual action of currents, or of Faraday's and Lenz's laws of induction.

The induction of currents in a transformer is, therefore, explained by the simple laws of cutting lines of force; when two or more wires lie parallel, and are encased in common by a sheathing of iron, the lines of force emanating from a primary wire when a current is started in it, cut the other wire, the secondary, in passing to the iron sheathing.

If the primary wire alone were encased by an iron sheathing, the lines of force from it would not pass outside of the iron casing; being retained by it, there would therefore be little or no induction in a secondary wire outside of the iron casing, even if quite near. This is made use of in some anti-induction wires, in which the wire which produces the induction is wound with iron tape or bands. This applies only to the primary or disturbing wire; a wire would not necessarily be protected from induction from others by being itself encased by iron; thus in the case of an electric light and a neighboring telephone wire, it is the former and not the latter which should be encased in an iron sheathing.

* C. H. in Journal of the Franklin Institute for July.

Different Kinds of Electricity.

To the tyro in electric science the different terms by which electricity is designated are very perplexing. He finds in common use the terms frictional, static, current dynamic, galvanic, voltaic, chemical, magneto, thermo, positive, negative, applied to electricity, and he naturally wonders how there can be so many different kinds, and in what respects they differ from each other.

An examination of the text books is not likely to relieve his perplexity, for the authors themselves, in many instances, have no clear ideas on the subject, and inventors who have devoted their attention to the practical application of electricity to some special industry, as telegraphy, telephony, or electric lighting are apt to be so much engrossed with their specialty that they have not kept pace with the advancement made in the development of electricity as a science, and hence their writings often betray an adherence to old theories and obsolete terms.

The different terms quoted above refer chiefly to the different methods by which electricity is generated, and to the conditions in which its phenomena are observed, and should not be understood as implying any difference in the nature of electricity itself. These terms apply to electricity in somewhat the same sense as the terms hot and cold, still and running apply to water; the nature of water remains unchanged whether hot or cold, whether found in a pond or a running brook. In like manner electricity remains unchanged as to its nature though generated by different methods, and observed under different conditions.

The term frictional designates electricity when produced in any method by friction; the term static refers to electricity when in a state of rest, or limited movement, as distinct from electricity when flowing in currents. But both frictional and static are nearly synonymous, except that the latter term applies also to electricity generated by induction machines, like the Holtz. The terms galvanic, voltaic, and chemical all designate electricity generated by the battery, and in this respect are synonymous. The term current electricity was formerly used to distinguish electricity when flowing in currents, generated by the battery or otherwise, from static electricity, but since the invention of the dynamo the term dynamic is preferred. Magneto, used as a prefix, designates electricity produced by magnetism, whether by the dynamo, or similar machines of smaller size, and thermo designates electricity produced by heat as in the thermopile.

Fig. 4—Fort Wayne Jenney Incandescent System.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number II.

The Dynamo. — Its Mode of Action. — It has been shown that lines of magnetic force from the poles of the field magnets radiate into the space between them, known as the magnetic field. The direction of these lines is from the pole technically known as the north to the one

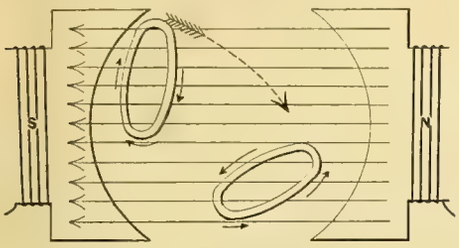

Fig. 4.

known as the south pole; and their number may be considered infinite throughout the field, though more numerous in some parts than in others. When a coil of wire is rotated in this field, temporary electric currents circulate in the wire at right angles to the magnetic lines which pass through the coil, and the electro-motive force of this current varies as the number of those lines.

Difference of Potential.—It is absolutely necessary in the generation of these currents that the magnetic intensity should vary or, as technically termed, that there should be a difference of magnetic potential at different points; and this difference is produced, as shown in Fig. 4, by the different positions of the armature coils, as they rotate, with reference to the lines of force. When the coil is in the upper left-hand position, with its plane at right angles to the lines of force, it embraces a far greater number than when in the lower right-hand position, where

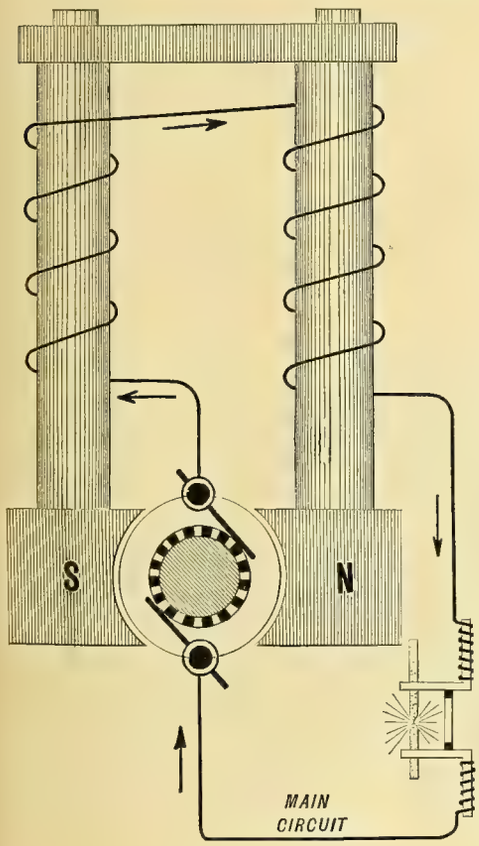

Fig. 5.

its plane is coming into a position parallel to those lines, so that, even in a perfectly uniform magnetic field, there is a constant change of magnetic potential, and consequently of electric potential. As the object of every electric generator is to create and maintain a difference of electric potential, it is evident that if the armature rotated in a uniform field, with its axis parallel to the magnetic lines, so that the number passing through the coils was always the same, and in the same direction, there would be no difference either of magnetic or electric potential, and hence no current. The generation of the current depends on the fact that the coils cut across those lines, continually changing position, and embracing a number varying from zero to a maximum—the lines in one-half of the circuit threading through them in one direction, and in the other half in the opposite direction, as the position of the coils with reference to the lines is reversed — the current always flows from the point where the electric energy is greatest to the point where it is least; that is, technically, from higher to lower potential, just as water flows from a higher to a lower level, or steam rushes through a pipe from where the pressure is greatest to where it is least.

Reversed Currents.—The direction of the electric current, as already stated, is always at right angles to that of the magnetic lines, and when, by the rotation of the armature, the movement of the coils, as viewed from the point

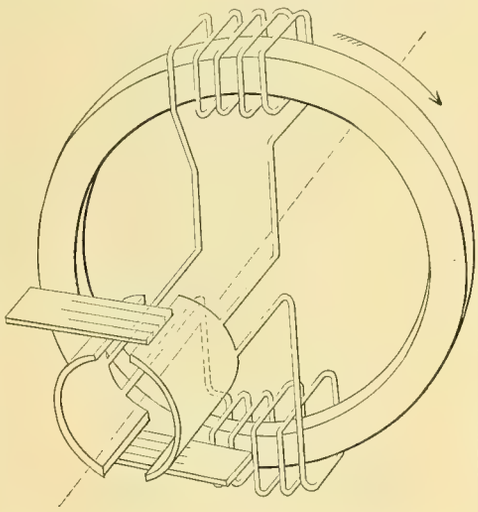

Fig. 6.

towards which the magnetic force moves, is such as to increase the number of lines intercepted, the current circulates in the coils in the same direction as the hands of a watch move, as shown at the upper left-hand corner of Fig. 4; but when the movement is such as to diminish the number of lines intercepted, this direction is reversed, as shown at the lower right-hand corner; this last direction being known as the positive sense and the former as the negative.

It is evident, then, that at each revolution of the armature two distinct electric currents are generated in its coils, one during each half revolution; that each coil passes through two neutral points where its position is such that it does not intercept any of the magnetic lines, and also through two points where it intercepts a maximum number of those lines; that the current begins at the instant the first neutral point is passed, increases as the intercepted lines increase till the first maximum point is reached, diminishes as they decrease, and vanishes at the second neutral point. Here a new current begins, and the position of the coil being reversed, the direction of the current is reversed also, while otherwise it passes through the same phases of increase and decrease as the first current.

Commutation.—By reference to Fig. 5 it will be seen that these currents are taken up by the brushes and circulate in the direction shown by the arrows through the coils of the field magnets and the exterior circuit in which the lamp is placed. If there were no commutator the currents in this circuit would be reversed, as in the armature, and we would have the alternate current dynamo, which constitutes a distinct class; but it will be seen by Fig 6 that at the instant the armature current is reversed the position of opposite segments of the commutator, with reference to the brushes, is reversed also, so that the opposite currents of the armature are commuted or changed into the same direction in the field magnet coils and lamp circuit, each segment, as it moves out of contact with one brush, moving into contact with the opposite brush.

But if there were only two segments in the commutator, it is evident that there would occur a break in the current at each half revolution, as the brush contacts changed simultaneously from one segment to the other. But with four segments at right angles to each other, as shown in Fig. 7, the current becomes continuous, one pair being in contact while the other pair is passing the break. But the current, though continuous,

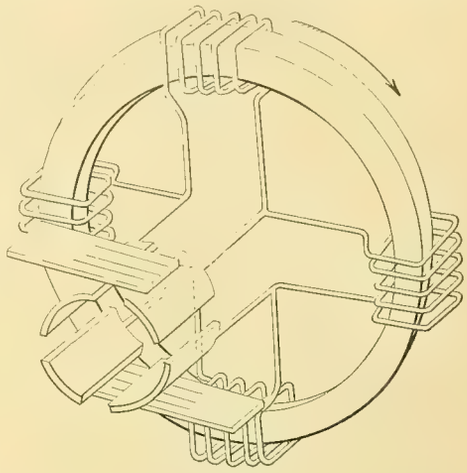

Fig. 7.

would be uneven, rising and falling in waves as the coils passed from the neutral to the maximum points, and round again to the neutral This is corrected by multiplying the segments and coils, as shown in Fig. 1, thus multiplying the number of waves, and reducing their length and intensity in the same ratio.

In closed circuit armatures, as represented in Fig 1, the several currents reinforce each other, the coils being all connected with each other, and each one also with a separate segment of the commutator, so that there is a constant increase of electro-motive force from one brush to the other as the armature revolves; the current from

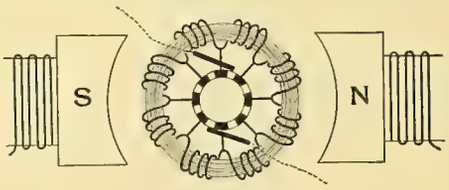

Fig. 1.

the exterior circuit entering at the lower left-hand brush, as shown in Fig. 5, and emerging at the upper right-hand brush.

It is a popular notion that the fur of the domestic cat has special electric qualities, and this notion has received quasi-scientific sanction from the fact that in treatises on static electricity cat skin is generally recommended as an excitant for the Holtz machine, the electrophorus, and the various instruments required for simple laboratory work. Every child has produced sparks from the cat's fur when stroked in the dark, and probably many of the men who have risen to eminence ar electricians have received their first lessons from puss; so that the universal prevalence of this notion is easily accounted for. But as a scientific fact there is no evidence that cat's fur is a better excitant than any other fur of equal fineness, and its only special recommendation is its cheapness. Fur and hair of all kinds are non-conductors, and can be used in generating electricity by friction in the same way as any non-conductor, since the electricity does not easily escape as when excited on a conductor requiring special insulation. The writer has used rabbit's fur as an excitant for the electrophorus and other instruments for which cat's fur is recommended, and with equal success. The advantage of a skin covered with fur over one covered with hair, for this purpose, consists in the closeness and density of the fur, rather than in any superior insulating qualities.

In late English experiments a red-hot wire was made to serve as a telephone transmitter.

Police Patrol System.

The illustrations herewith give a very clear and comprehensive idea of the workings of a police patrol system, and show the latest improvements, electrical and otherwise, in the apparatus. The system is that of the Police Telephone Signal Co. of Chicago.

Figure 1 shows the ordinary octagonal street station with the door open, exposing the alarm box to view, and showing a lamp on top. In the larger cities of this country, these stations are so familiar that a detailed description is unnecessary. The keys of these stations are placed in the hands of responsible citizens, and also with the patrolman of the district. The locks are uniform, and one key will unlock any of the stations.

Fig. 2 is an enlarged view of the alarm box, with the door closed, and showing the lever in front for use by citizens in sending an alarm to the police station.

Fig. 3 shows the mechanism of the box. To this part of the apparatus only officers have keys. The inside box disclosed in this figure, contains a signal apparatus and a complete telephone outfit, which can be used by the patrolman for the transmission of orders to and from headquarters, or for reports during the hours of duty. The arrangement is such that the working of the signal boxes does not interfere with the telephone line or vice versa—a feature that makes the system doubly valuable.

Fig. 4 is a modified form of the alarm box. It is what is known as a wall box, and is designed to be attached to the wall of a building or a post or other place where an octagon street station would be impracticable. As will be noted, it consists of an outer and inner iron case, the design of the outer case being to prevent malicious persons from meddling with the box. The inner case contains substantially the same mechanism as fig. 3, with the addition of a pendant frost-proof case to contain a local battery for the telephone outfit.

Fig. 5 is a signal box of happy conception. It is specially constructed for use in private residences, banks, hotels, business offices and the like. When a signal box is placed in a private residence, a key of the house is left at the police station under seal. In case the occupants of the house have occasion, at any time, to call for the assistance of the police, they can do so by simply pulling the lever attached to the box, and they can also indicate the nature of their want by using any one of the different signals; that is, they may indicate burglars, drunken servant, fire, etc. When a call is made, the occupants of the house can, if desirable, remain quietly in their bed-rooms, while the policeman answering the

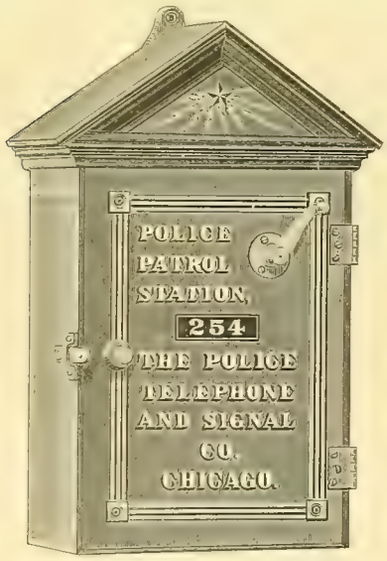

Fig. 2.

call takes the key of their house from its place, and having reached the house, steps quietly in at the front door, to the great discomfiture of the thieves, burglars, or intruders. The owner of the alarm box can, each night, if he wishes, before retiring, give what is called the "test of the line" signal; and the answering ring on the bell shows that the line is in working order. A feature of the signal apparatus is, that after transmission of the call, a small bell attached to the instrument is made to give one blow; this assures the person calling for help that his call has been heard, and is sure to be answered.

A description of the system would not be complete without at least a bare mention of the patrol wagon, that forms so essential a part. A

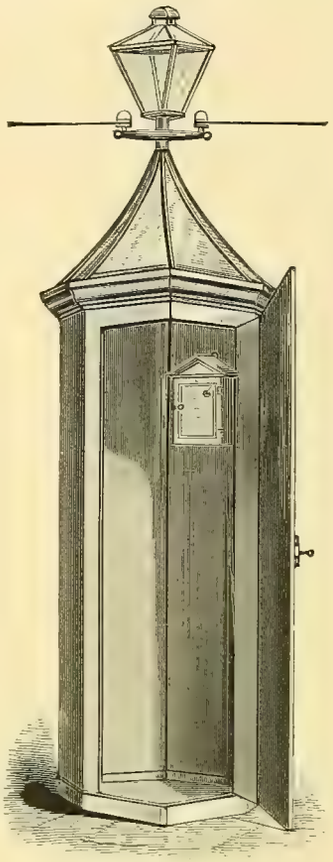

Fig. 1.

call from a box over the line to the police station, unless accompanied with an explanation verbally through the telephone, or through the medium of signals, means nothing more than that help is wanted at that particular place. The cause of the alarm may be a refractory prisoner in the hands of a police officer; it may be a thoroughly inebriated individual too much intoxicated to even stand; it may be a sudden death from disease, by sun stroke or by accident, or it may be caused by any one of the thousand necessities that drive the public to seek the police. The wagons have to be constructed to meet all emergencies.

Fig. 6 shows a wagon from the rear. The hooks attached to the seats, but which are detachable, are designed to support a stretcher on which an injured prisoner or citizen may be transported to a place where his injuries may be attended to. The end of the stretcher is shown in fig. 7. The stretcher is rolled when not in use and stowed in the locker shown at the left of the end of the wagon in fig. 6. The locker under the seat of the driver in the same figure is designed to carry rolls of lint, bandages, splints and such articles as could be used by any one without special education in surgery at critical times, such as stopping the flow of blood from an artery and the like.

Fig. 7 shows another view of the wagon with a cover spread over it, and so arranged as to admit air, while protecting the one on the stretcher from a hot sun or a beating storm. It is a most admirable contrivance.

Incandescent Light vs. Gas.

By Ixion.

The use of incandescent light is becoming general throughout the entire country, and as a competitor to gas, it has long since demonstrated its ability to take its proper rank as the best and cheapest illuminant. There can now be no question that incandescent light can be supplied as cheaply as gas under almost all conditions. The residents of our western towns have appreciated this fact, and it is now quite common to see incandescent light furnished from central stations, and used in the stores, public halls and residences, in towns of even less than one thousand inhabitants. In many of the states which are well supplied with water power, the light is furnished to consumers at a price which as compared with that of gas would be from eighty to ninety cents per thousand feet, and even where steam is used as a motive power, the light is furnished at prices varying from seventy-five cents to one dollar per month per 16 candle power light, which is about the same price that gas would cost on a basis of from $1.25 to $1.75 per thousand feet.

The introduction of the long distance and alternating current systems, now manufactured by some of the prominent electric lighting companies, has made the gas companies change their opinions regarding the practicability of incandescent lighting from central stations, and we now find many local incandescent lighting companies supplying the streets of towns with incandescent lights in the face of gas competition. For street lighting purposes the incandescent lights are placed at the street corners, and in places where gas lamps previously held sway, and they give a much more satisfactory light. The old familiar gas lighter, carrying his torch, and mounted on his 2.10 (?) rawbone horse, galloping wildly over the streets of a town lighting his gas lamps, will soon be a thing of the past, and will doubtless form part of our stories to our grandchildren. Such scenes will become relics of bygone days, and be classed with the "Ben Holliday Stage Coaches" and the "Pony Express."

Marvels surely are being brought to pass, and that which was considered impracticable, when the multiple arc and three wire plans of incandescent lighting were the only ones known or used, is now a reality by reason of the long distance and alternating current systems.

At Waukesha, Wis., from whence comes the famed Waukesha water, some eleven miles of line carry the current for lighting the city by incandescent light, and the competition with the gas company there for this branch of lighting, as well as for commercial and residence lighting,

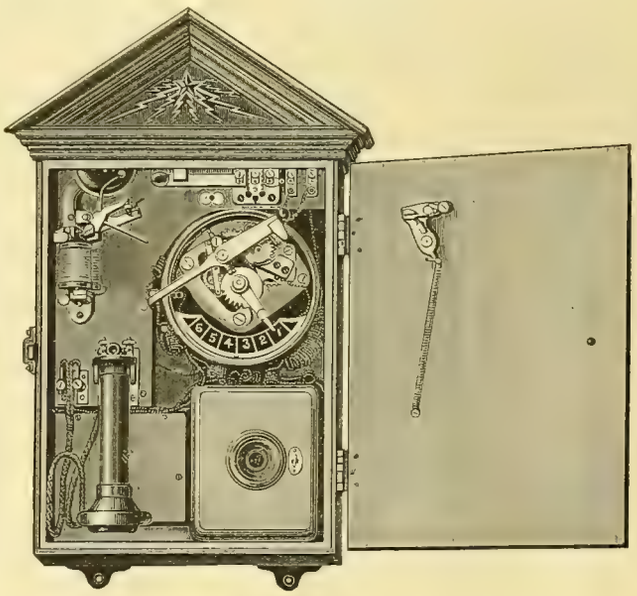

Fig. 3.

has been so formidable, that the gas company has purchased all the apparatus, wires and franchise of the electric light company, and is now supplying the residents of said city with both incandescent light and gas. This is but an instance of the many that herald the success of incandescent light as a competitor to gas.

In regard to the question of quality of incandescent light as compared with gas, there is no room for argument, and the matter has been gone over so fully in previous articles on the subject, that it is useless to tax the time of the reader with a repetition. Incandescent light is making its own way in the esteem of the public, and the many projected stations for supplying this acceptable illuminant, furnish a satisfactory proof that our friends in the electric lighting business are wide awake to their interests, and need no hints as to the manner of pushing their business. We simply say, push on—success is crowning your efforts, and every light introduced is but a stepping stone to thousands more.

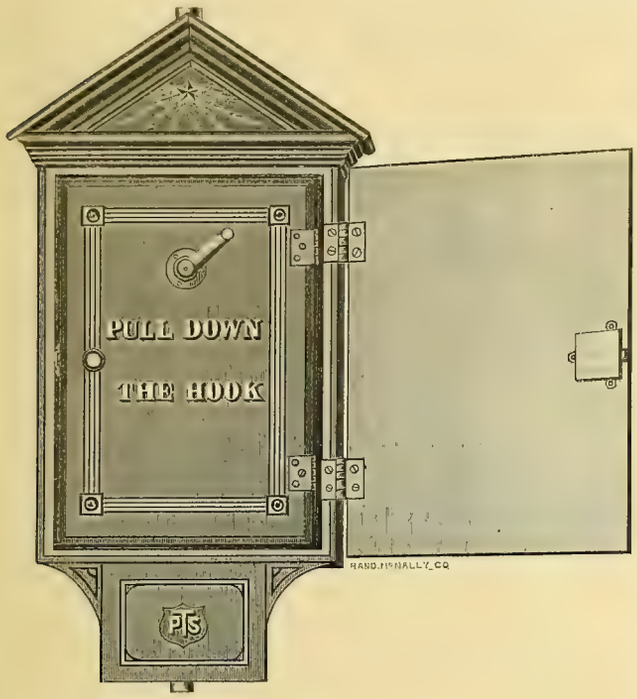

Fig. 4.

One can imagine the vast importance the incandescent lighting business is bound to assume in the next five or ten years, when one stops to think that the lamps have a certain duration of life, and that each one will in time be many times renewed. It therefore can readily be seen the vast proportions the manufacture of these lamps must reach. The business is now conducted on a very large scale, but in the future it must be one of the foremost industries in the country.

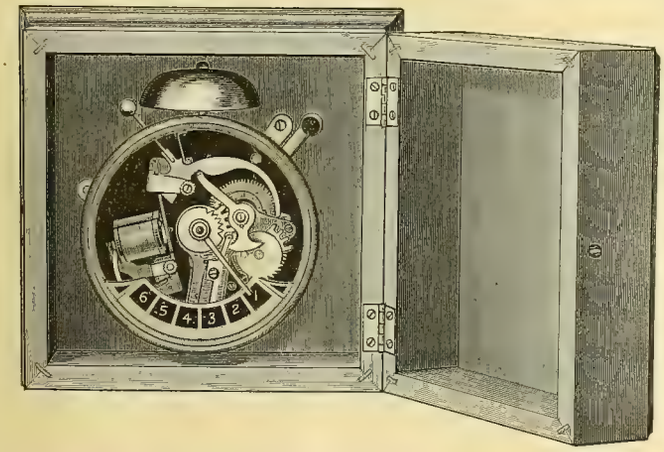

Fig. 5.

There is scarcely an office building erected at the present time in which a plant is not installed, and incandescent light in a first class office building seems to be as necessary as steam heat or elevator service. Our prominent factories, mills, hotels and public buildings generally all over the country, either rent incandescent light from central stations, own their own incandescent plants, or are contemplating their purchase; and the question of supremacy between incandescent light and gas is already decided in favor of the former. The battle has been won, and it only remains for our enterprising brethren of the electric light to pursue the advantage gained. Like all things in nature, it resolves itself into "the survival of the fittest."

Awaiting the Telephone Decision.

There are several thousand persons in the country who are anxiously scanning the Washington news for the information which may be expected almost any day that the Supreme court has decided for or against Bell's claim to the telephone patents. Not a few of them are located in Chicago. As time draws on interest grows more intense. A short time ago, however, there was a sudden break in Bell Telephone stock in Boston. In half an hour the rumor ran around this city that the court had decided against the Bell company, and there was a skurrying of investors to brokers' offices and a fall in the stock. The rumor was contradicted and the stock reacted. What a shaking up there is likely to be if the highest tribunal in the land shall declare the telephone practically public property! There are five or six companies having headquarters in this city, says the Chicago *Herald*, which are waiting for the word to jump into the field and fight with the Bell for business. Some of them have already invested many thousands, and they have a most intense interest in the words which Chief Justice Waite will utter. Aladdin's lamp and the wonders it performed seem not more wonderful than the quick road to riches the telephone pointed out to those who were in it at its beginning. One of the Bell company's chief officers in Chicago was a counter clerk in the telegraph office. He undertook to harmonize two conflicting interests, one of them vested in the Vanderbilt family, and succeeded so well that he was paid $100,000 for the job and let in on the ground floor besides. Subsequent investments in the stock rolled his fortune up to $300,000. A boy about eighteen was taken in to help as an electrician, having talent in that direction. He was given stock in payment. It increased in value rapidly enough to make a fifty-year old man's head swim. Before he had attained his majority the boy was worth $50,000, which he could proudly say he made himself. A telegraph operator resigned a situation worth $50 a month to enter the infant telephone company's employ, because his health required a more active life. He, too, was paid in stock, and in a year had climbed from poverty into affluence. There are scores of such cases. The big money which the little fellows made all came in the first year or two. There has been little for them since, save in the shape of fatter dividends than any other enterprise can afford to pay unless it is the Standard Oil company or a Chicago pool-room.

Electric Experience of a Panama Farmer.

Recent advices from Panama say: "A most extraordinary event occurred recently to a farmer living in Cundunamarca. He had been superintending some work which was being done in the fields, and had left his men to return to his home, when he was surrounded by an electric flame which disappeared as quickly as it came. The victim's left eye was damaged, and the eyebrow was burned completely off. The hair surrounding his ears, a portion of his beard and all the hair on his breast was burned off. All the brass buttons disappeared from his clothing, his watch chain was cut in two, a small hole was bored through his watch-case, and the watch-glass was shattered, and his right side was burned. He suffered severely, but is recovering rapidly under medical treatment."

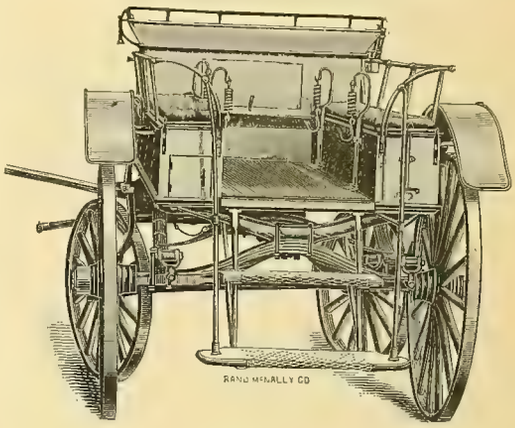

Fig. 6.

Instances like the above are by no means uncommon. It is evident that the man was struck by lightning and was at the time under a thundercloud, though this circumstance is not mentioned. But whether the direction of the electric discharge was from the cloud to the earth or from the earth to the cloud can not be known. In either case the man's body was in the line of least resistance between earth and cloud. It is also evident, that instead of being "surrounded by an electric flame," the charge traversed the front surface of his body diagonally between the left eye and right side, taking in its course the hair about the ears, the eyebrow, beard, hair on the breast, brass buttons, watch and chain, and right side, either entering at his eye and emerging at his side or vice versa. The brass buttons and watch and chain, being good conductors, undoubtedly saved his life, confining the charge chiefly to the surface.

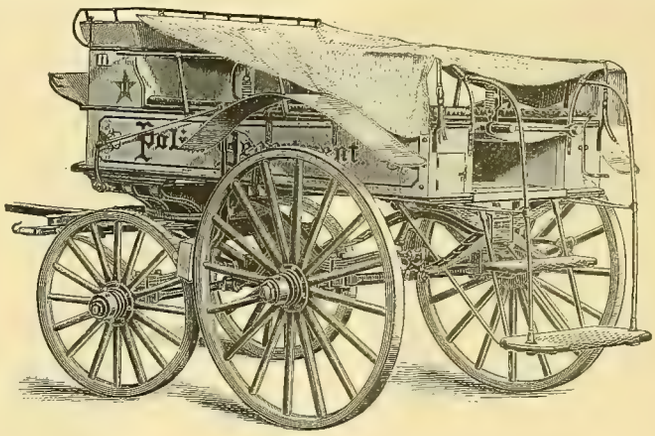

Fig. 7.

As there must have been thunder, coincident with the lightning, the fact that he does not appear to have heard it, was doubtless the result of his being stunned by the discharge. And this is probably true in all similar cases; so that the trite saying that a person killed by lightning "never knew what hurt him" is doubtless literally true.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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THERE is a lively agitation in the carbon trade. It looks as though the result will be lower prices than those asked by the United Carbon Companies.

It is well known that just before the Cleveland combination was consummated most of the electric lighting companies loaded up with a liberal supply of carbons at the old prices. They loaded up so heavily that it is probable very few of them have so far paid the new and higher prices for any considerable number of carbons. As the time draws near, however, when this stock will become exhausted, the electric lighting companies are beginning to look about them to see what they can do in the way of getting carbons at prices lower than those asked by the United Carbon Companies.

The interest taken in the matter is shown by the attempt already made by the lighting companies to make carbons for themseives, and to build up a combination in opposition to the United Carbon Companies. If the lighting companies go ahead and commence the manufacture of carbons, the United Carbon Companies will be obliged to compete, and the result will be a price considerably lower than $25.

In fact, it is probable, if the present agitation continues, that the Cleveland combination itself will lower its prices somewhat. And it should be borne in mind, too, that all of the carbon companies are not in the combination, and competition is bound to come from these outside companies.

It is our own opinion, everything considered, that very few, if any, lighting companies will find it necessary to pay $25 a thousand for their carbons.

Chicago Electric Club.

The next meeting of the Chicago Electric Club will be held Monday evening, July 11th, at 8 o'clock. This meeting will be held in the club's own rooms, on the first floor of 223 Dearborn street. All having the interest of the club at heart should attend, and members should make a special effort to be present. The entertainment committee promise an interesting literary programme.

ELMER A. SPERRY, a well-known and popular electrician of Chicago, was united in marriage to Miss Lulu Goodman, daughter of Mr. and Mrs. Edward Goodman, June 28th. Many friends will unite with the WESTERN ELECTRICIAN in wishes for much happiness.

COMMENTS, queries, notes, descriptions of new electrical appliances, or communications on subjects of interest to the profession will be welcome at any time. It should be borne in mind, however, that the WESTERN ELECTRICIAN will not hold itself responsible for the opinions of its correspondents.

THE air is again thick with rumors concerning the probable gobbling up of the Baltimore & Ohio Telegraph Company by the Western Union. These rumors recur with a good deal of regularity, but never amount to anything. It is possible, however, that there may be something in them this time. Some sort of negotiations are undoubtedly under way, but the Western Union evidently finds the Baltimore & Ohio a little high-priced.

A DISPATCH of July 4 says: "Yesterday morning about 1 o'clock lightning struck the cupola of the Lyon County Court House at Emporia, Kan., ran down the lightning-rod to the second floor, and then entered the building, setting it on fire. The sheriff and family and several prisoners were stunned, and the building considerably damaged." This is evidently another of the many instances of damage by a defective lightning-rod, resulting probably either from a bad joint, insufficient conducting capacity, imperfect ground connection, or a combination of these causes. A well constructed rod, if in proper condition, would undoubtedly have saved the building.

THE police patrol system shown on the preceding pages illustrates but a single branch of the useful application of electricity, yet a very important branch in cities. The report of the superintendent of police of Chicago for the year ending Dec. 31, 1886, gives data which show the value of a system of this character. The total number of men constituting the police department was 1,036, and of this number 104 were detailed to the patrol service. The number of arrests made by the entire force was 44,261, and of this number the patrol service of 104 men made 19,058 arrests, or 10 per cent. of the force made about 43 per cent of the arrests. In addition to this duty the patrol service attended 1,315 fires, took 1,376 sick and injured persons to hospitals, suppressed 2,589 disturbances without making arrests, transferred 1,998 prisoners to the county jail and 6,846 persons to the division police court, and responded to several thousand miscellaneous calls. Our article shows some recent improvements in this admirable system.

THE last number of the WESTERN ELECTRICIAN contained a reproduction of a chat with Professor Barrett, city electrician of Chicago, on the bridge nuisance of Chicago and the remedy he proposed. At a meeting of the city council held just before the paper went to press the plan slightly modified was adopted, and the work is under way. A small house has been built on one of the piers in the harbor and will be used as a main telephone office. Each of the bridges on the river to Twelfth street on the south branch, and Chicago avenue on the north branch, will be connected by telephone to the main "dispatcher's" office, as the professor has been pleased to term it. For the first few weeks, at any rate, he will be in charge and will control the movements of vessels entering or departing from the river after the plan described heretofore. A few weeks' trial will show what system will do in solving the perplexing problem, and undoubtedly a reduction of the nuisance will follow the inception of the plan.

THE series of articles begun in the first number of this journal on the elements of electric lighting, written by an editor of the WESTERN ELECTRICIAN, are designed to meet the wants of those who wish to learn something about the principles of the electric light, but do not know where to apply for the primary knowledge. The articles, as is obvious, are not intended for the instruction of experts but for learners. The aim has been to describe the essential parts and explain the purpose of each in plain simple language devoid, as far as possible, of scientific terms. The volume of business done by the electric light companies is constantly increasing, and the next decade will see a very large proportion of the country lighted by electricity. This will call for men skilled in the construction and use of the dynamo, and further means that nearly every steam engineer in the country must know the principles of electric lightning or give place to another more progressive engineer, who has posted himself on the principles. There is not a gas company superintendent, who is not directly interested in the future of electric lighting nor a business man, who does not desire to learn something about the elements. To all these, the articles referred to are directed. We believe they will be appreciated.

THE largest secondary battery yet constructed is probably that in the basement of the city hall of Paris. It includes 165 gigantic elements, 10 inches in diameter and 31 inches in height, and it yields a power of 100 horses. It weighs eleven tons and contains 975 gallons of liquid. Its purpose is to regulate the 2,200 Edison lamps that light the hall of Fetes and the adjacent salons, the contract requiring that the battery shall keep up the light from twenty to thirty minutes in case of accidental stoppage of the machines. The current-producing machines for this part of the illumination alone are three large Gramme dynamos and four steam engines, of a total power of about 130 horses.

The Phonophore.

THE London papers bring interesting details of experiments with a new electrical instrument called the phonophore, which has been designed by C. Langdon Davis. While investigating the induction noises caused in telephone wires he discovered the existence of an electric force which can be separated altogether from the ordinary electrical currents, and which can pass freely through insulators impassable by the currents. In exterior form the transmitter appears to be an ordinary Morse key mounted on a base about four inches high. This base contains an instrument which somewhat resembles an induction coil. The impulses are generated in a primary circuit of improved construction, over which is wound in place of a secondary circuit a secondary circuit a phonophore of two wires, insulated from each other throughout their entire length and at both ends; each of these wires being, however, connected at one end only to the telegraph wires. The phonophoric impulses generated in the transmitter are regulated in and received by organ reeds and by means of a new form of contact breaker. Recently five experiments were successfully carried out, as follows: A phonophore message was transmitted alone from Folkestone to London, and there received by a working postoffice, universal relay and an ordinary Morse sounder. Second, a similar phonophore message was transmitted and received while an ordinary telegraphic message was traveling in the same direction between the stations. Third, a phonophore message was transmitted and received while an ordinary telegraph message was being transmitted in an opposite direction between the same stations Fourth, a phonophore message was transmitted and received between terminal stations while an ordinary telegraph message was being transmitted between two intermediate stations; and fifth, phonophore messages were freely exchanged between terminal points after the line had been disconnected between London and Folkestone, and while the circuit was absolutely broken.

The Telephone Ordinance.

At the city council meeting Wednesday evening, it was decided to postpone action on the telephone ordinance until the next regular meeting. This is the ordinance which proposes to tax telephones twenty-five dollars a year.

Theory of Telephone Cables.

By Dr. V. Wietlisbach in Elektrotechnische Randschau.

Part II.

The intensity of the current entering the cable is always regarded as 1. For instance, I take the telephone cable of Felten & Guilleaume of Muhlheim, which is in general use in Germany. This cable has 27 conductors, of which each one has a resistance per km. of 45 ohms, and a capacity of 0.24 microfarads. I undertake to determine the lengths of cable which will diminish by one-half the intensity of tones produced by waves of 100, 500, 1,000 and 2,000 oscillations per second. The curve of the figure shows that the intensity at the end of the cable is one-half of that at its beginning, if n C. W. is equal to 1,188. If we calculate from this the corresponding lengths of cables for different pitches of tones, we will have for a tone with 100 vibrations a cable of 33 km., 500 vibrations a cable of 14 km., 1,000 vibrations a cable of 10 km., 2,000 vibrations a cable of 7.4 km. From this it may be seen how great an influence the number of oscillations has upon the weakening of the tone. It is even clearer in the following table in which the weakening of different high pitches in various lengths of cables have been gathered together.

Number of Oscillations.	1 KM	5 KM.	10 KM	15 KM.	20 KM.	50 KM.
100	1.00	1.00	0.99	0 95	0.87	0.19
500	1.00	0 98	0 81	0.50	0 27	0 00
1,000	1.00	0.94	0.54	0.22	0 08	0.00
2,000	1.00	0 81	0 27	0 07	0.01	0.00

This influence of the number of oscillations must be given great prominence for this reason; because it determines the cable lengths through which articulation is possible. The sounds and noises which are employed in human speech are of a very complicated nature, and their analysis has been only partially possible up to the present time. It is known of the vowels that they are made of a fundamental tone and a certain number of harmonic overtones, and that they are for that reason characterized by the following three conditions, viz.:

1. By the pitch of the fundamental tone.
2. By the number of concomitant harmonic overtones.
3. By the intensity of these separate overtones.

As the new researches of Lahr (Wiedemann annal 27, page 94, 1886) seem to show, the overtones for one and the same vowel change as well in pitch as in intensity, if this vowel is spoken in different registry, and the combination is different according to the peculiar inflection of the different organs of speech, and for this reason the measurements which are arrived at by different scientists do not exactly agree.

The following table contains the combination of the more important vowels according to the measurement which Lahr has made. The fundamental tone at which the vowels were spoken is f' with 350 vibrations per second. In order to make this matter clearer, only the overtones essentially characterizing the vowel in question are adduced. Those which are accidental and due to the inflection of the voice have been disregarded:

Vowel.	$f=J_1$	$f'=J_2$	$c''=J_3$	$f''=J_4$	$a''=J_5$	$c'''=J_6$	$dis'''=J_7$	$f'''=J_8$	$g'''=J_9$
u	1	0.28	------	------	------	------	------	------	------
ü	1	------	------	------	------	0 40	------	------	------
i	1	------	------	------	------	------	------	0.19	------
a	1	0.88	0 91	1 84	1 37	1 80	2.11	0.05	0.04
o	1	24.4	------	22.8	------	------	------	------	------
ä	1	------	27.2	7.33	25.6	1 7	9.07	11.8	4 29
ö	1	------	3 90	4 56	1.25	------	------	------	------
e	1	0.70	------	------	------	------	------	1 15	2.11

The vowel in which overtones are especially prominent is "a." Let us investigate to see what has become of the different partial tones after this vowel has traversed a certain length of the telephone cable. We must remember that the intensity or energy of a vibration is proportional to the square of the amplitude, and the square of the number of vibrations. In the table the largeness of the amplitudes is given and hence the intensity of the partial tones must be multiplied by the squares of the factors which are obtained from it.

The table below shows the value of the intensities of the different partial tones for cables of 1, 5, 10 and 15 kms. length.

Cable Length.	J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8	J_9
0	1.	0.88	0 91	1.84	1.37	1.80	2 11	0.05	0 40
1 km.	1.	0.88	0.91	1.84	1 37	1 80	2 10	0 05	0 39
5 km.	0.98	0.81	0 77	1.38	0.89	1.03	1 02	0.02	0.12
10 km.	0 75	0.36	0.20	0.23	0.09	0.08	0 06	0.00	0.00
15 km.	0.53	0.08	0.03	0.02	0.00	0.00	0.00	0.00	0.00

At the end of one km. the intensity of the partial tones remains almost unchanged. At 5 km. the upper partial tones are decidedly weakened. At 10 km. the intensity of the fundamental tones amounts to three-quarters of the original intensity. The high partial tones disappear entirely, and at 15 km. the intensity of the fundamental tones sinks to one-tenth of its original value.

One can conclude from this that very good articulation is possible through one km.; that through 5 km. it is good; at 10 km. it becomes difficult and at 15 km. impossible.

As the higher tones are much more quickly muffled than the deep ones, it might be concluded that deep voices are better suited to talk over cables than high voices, but according to the theory of Grassmann and the measurement of Lahr the characteristic partial tones of tones more highly pitched are relatively deeper. For that reason the character of the tone maintains itself in spite of a greater weakening almost as well as in the case of deep tones, and our experience is that male and female voices are almost equally well transmitted. So far as the change in speed or the phase is concerned the value of this, too, can be calculated from the formulas set down above.

An Electrician's Views on Belting.

By Foree Bain.

One of the most important factors in the successful operation of an electric light and power station or plant is the matter of belting, and very frequently it is too lightly considered. At first thought a mere band or strap to "make the wheels go around," seems all that is necessary. Let me offer the following, obtained from experience and close observation of a practical electrician. The best belt that can be made is always the cheapest, regardless of cost. A hide tanned so as to solidify the gelatine without forming crystals is the best material out of which to make a belt, hence an oak-tanned short lap leather belt is the best belt for general purposes that can be had. There are some places, however, where a belt is exposed to extremely dry and hot atmospheres; in such places a cotton belt will answer better than any other. In very damp or wet places, rubber belts should be used. When a belt slips on a pulley it plainly indicates that it is either too loose or that it is not of sufficient width to perform the duty required of it. If a belt will not run a machine without making it so tight as to start the lace holes, it would be much better to substitute a wider belt. When a belt shows a tendency to tear out the lace holes it indicates too great a strain. On the other hand, a belt should not be allowed to run too loose, for it is this, more than anything else, that causes a rapidly revolving journal to chatter. A journal to wear well and smoothly must be held in place firmly by the belt. If it is permitted to run very long with a slack belt, it soon ceases to fit properly in its box and rapidly grows worse. A belt, to wear well, should be tight enough to exclude every particle of air from the surface of the pulley. The grain side of the belt should be run next to the pulley, as, being smooth and straight, it forms a better surface for adhesion, and it will transmit from 20 to 30 per cent. more power than when placed flesh side in. The flesh side should be placed outside for another reason: It is more elastic than the grain side, and will not so readily crack when going around small pulleys. When vertical belts are necessary, it is good policy to make them even wider in proportion than horizontal belts. They should be kept rather tighter than horizontal belts, and in most cases a "tightener" on the slack side is desirable. Crossed belts should never be used when they can be avoided. Their own friction causes great wear and also absorbs considerable power.

Belts should never be oiled. Experience will show that oil, or so-called dressing, will cause a belt to rot, and it will not last so long, or be as serviceable, as those which receive no oil or dressing. When a belt is oiled, it tends to make it stretch, and it thus becomes narrower and thinner, hence the belt loses some of its ability to transmit power.

Leather will not stand a greater strain than 450 pounds per square inch without showing signs of fracture when carefully examined under the microscope. Therefore, a belt should not be subjected to a tension of over 275 pounds per square inch. To be within the limit of reason, and the best service, a belt should not travel more than 2,500 feet per minute—a higher speed entails greater wear and shorter life.

I would advise covered pulleys in every case. It has been demonstrated that the adhesion of a leather belt to wooden pulleys is from 25 to 30 per cent. greater than to an ordinary iron pulley; the adhesion to pulleys covered with cotton about 65 per cent. greater; to pulleys covered with leather or paper 100 per cent., while rubber-covered pulleys increase the adhesion 150 per cent.

All belts should possess what is known in physics as reserve force. A belt should not be strained to its utmost. A belt exerting 50 per cent. of its capacity will wear better and last longer than if it were working 75 per cent. of its capacity.

A narrow belt does not necessarily indicate that a dynamo requires less power than if a much wider one were used. The writer has run ten full arc lights with a single flat leather belt, one-half inch wide, running 2,500 feet per minute. According to the well-known formula that a belt, one inch wide, traveling 1,100 feet per minute, will transmit one horse-power, this would indicate that only a little more than one-half horse-power was used. The dynamometer test, however, showed that this little one-half inch belt was doing the work for which at least a four-inch belt should be regularly employed. I mention this fact to show what a belt will do when "worked to death."

For dynamo work a well oak-tanned leather belt, with short laps—not shoulder stock—well glued and then stitched, is the best for the purpose. Copper burrs and rivets cause the belt to slip on an iron pulley, and with covered pulleys they rapidly wear the covering off. Pegged belts are liable to pull in two in dry weather, and belts depending on glue alone to hold them together are not to be trusted. Care should be taken to see that the belt is of a regular even thickness, so that it will not run out of balance when in use, a source of a great deal of annoyance and wear. Always run the slack side of the belt on top and never otherwise if it can possibly be avoided. Remove the belts from the pulleys when not in use, if at all practicable.

If the static effect from a fast running belt is annoying, it may be entirely removed by placing a sharp pointed wire within one-half inch of the belt and running the other end of the wire to ground. Never use a double belt on a pulley less than thirty-six inches in diameter. A heavy single belt is better even then. Never use resin, soap or anything of the kind on a belt; this is only temporary relief, and it ruins your belt. The only remedy is a wider belt. Always run a belt on the pulleys in a direction tending to smooth the lap and not against the lap.

The Telephone Service company, of Chicago, was incorporated Wednesday, with a capital stock of $500,000. D. C. Batey, David J. Revell, and Charles S. Owen are the incorporators.

Williams' Compound Engine.

Engineering practice has proven the advantages of expanding steam in more than one cylinder in a single engine. The principal of these is economy in the use of steam. Another and hardly less important feature is, that the distribution of pressures is much better for high rotative and piston speeds in the compound than in the single cylinder condensing engine, which is next to it in economy. Transatlantic steam ships are now using either compound or triple expansion engines with scarcely an exception. The demand of ship owners for engines capable of the greatest power for a given amount of fuel, has hastened the development of economical engines on the seas more rapidly than ashore; and the steadily increasing demand in the general market to-day for compound engines is a natural sequence to successful marine practice.

In view of meeting future calls for the highest economy in the use of steam combined with compactness, moderate cost, steadiness of rotation, and accuracy of regulation, Mr. Edwin F. Williams, of Chicago, Ill., is preparing for the market his high speed compound condensing automatic engine, which we are now at liberty to publish. Descriptive engravings Nos. 1, 2, 3, 4 and 5, refer to this engine.

Fig. 1.

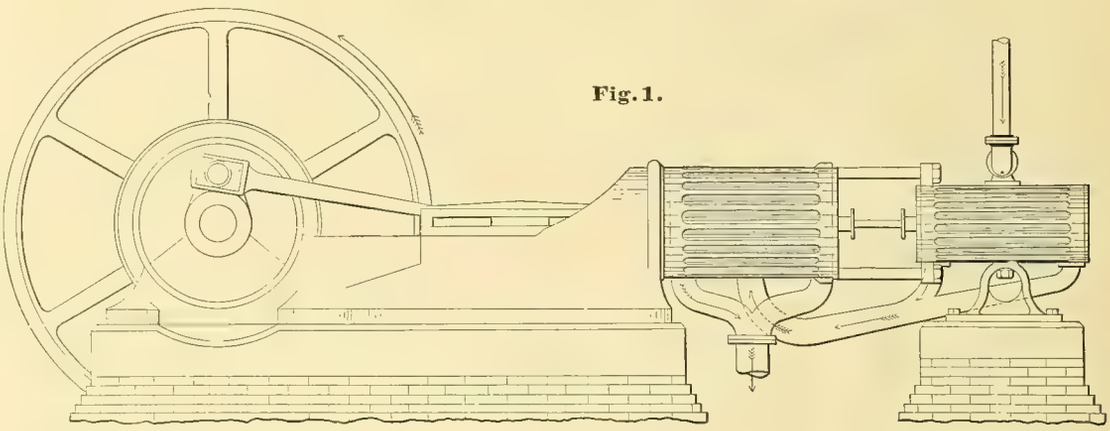


Fig. 2.

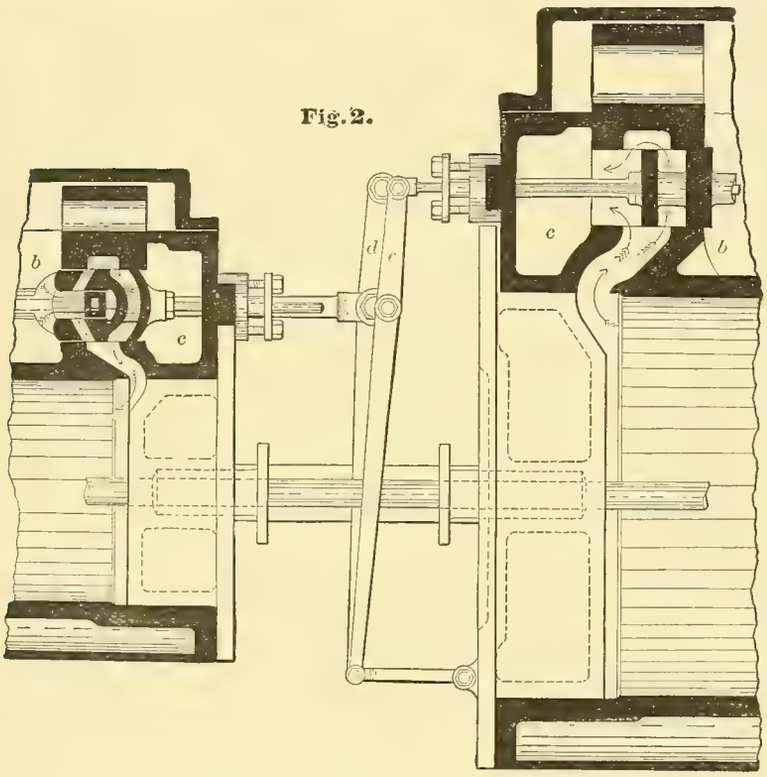


Figure 1 is an elevation showing the arrangement of cylinders, the steam connections, style of frame, crank and connecting rod, without other details. As it will be observed, the cylinders are tandem, the frame of the Porter type, "solid end" connecting rod, and disc crank. The foundation extends sufficiently back from the end of the frame to support the small pier and cap stone underneath the high pressure cylinder. Allowance is made for expansion and contraction by slotting the upper bolt hole in the base piece of the small cylinder. The frame, crank shaft, and crank pin, are proportioned much larger than is customary in compounds. Bearings are large in diameter and short, insuring stiffness. The reciprocating parts are light, and of strong material.

Figure 2 shows the valve rod connections between the two cylinders, also sections of the H. P. and L. P. valves, seats and pressure plates. The steam chests are on the sides of the cylinders, the valve seats being in a vertical plane. There are two valve rods, one directly above the other, the lower one working the main valves of both cylinders and the upper one the cut-off valve of the high pressure cylinder, there being but one cut-off.

In the engraving the pistons are assumed to be moving from right to left. The arrows represent the localities and directions of steam currents. Clearance is reduced to the amount required to admit of a properly formed compression curve for economy and at the same time smoothness of engine performance.

For a better understanding of the valves refer to figure 3. The main valve (actuated by the stem *d*) carries within it the cut-off *e*, acting upon supplementary ports. Upon the back of the main valves, resting upon distance ledges are the pressure plates *a*, *a*, the inner faces of which are provided with cavities exactly opposite and equal in length and breadth with the steam ports. The valve seat and face of pressure plate therefore present two exactly equal and opposite faces, between which the valve works freely. Steam is admitted into the central portion of chest at *b*, and passes into the cylinder through the supplementary and main ports, as shown to the left. The exhaust, after passing back through the port, as shown to the right, drops down out of the chest at *c*, *c*, and is carried into the exhaust pipe by the two branches of the y pipe, as shown in figure 1. This arrangement secures an excellent separation of "live" steam from exhaust, and the latter is kept away from the working portions of the cylinder. The valve actions are all doubled. In this system a 15″ port has the effect of a 30″ port in the ordinary systems. Indicator diagrams show a distribution of pressures at very high rotative and piston speeds equal to that obtained in the best moderate speed engines.

The valve gear, notwithstanding the light service it has to perform, is provided with hardened steel ground bearings, sufficient in size to run an unbalanced valve. This insures great durability. The pressure plates are worthy of special notice. They are very small and the pressures on the two sides so nearly equal, that no harm will result from putting them down full force on the valve. This solves the whole problem of leakage, as the valves will wear themselves tight and free, thus making a close fit, also insuring freedom of movement after little use.

Figure 4 is a view showing arrangement of cut-off and main eccentrics, also an elevation of rockers. The cut-off eccentric is mounted upon an eccentric sleeve of such diameter and relative position as to bring about any desired movement of cut-off valve riding within the main valve. The cut-off eccentric is acted upon by a shaft governor which rotates it about the axis of the eccentric sleeve forward or back, occasioning an earlier or later cut-off, as the load upon the engine may require.

The governor has an inertia disc acting in connection with light spring and weight forces, and is quite sensitive to sudden changes of load.

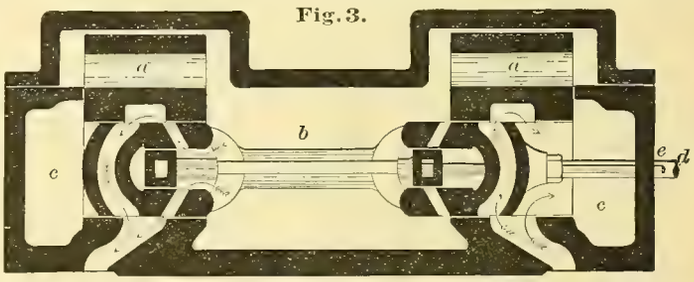
Figure 5 is a general plan of the valve gear.

Aluminum.

The *Iron Trade Review* of Cleveland publishes the following interesting information concerning aluminum:

Some important and very satisfactory experiments have been made at the Cleveland Rolling Mill company's works during the last two weeks in treating Siemens-Martin steel with small percentages of aluminum manufactured by the Cowles Electric Smelting & Aluminum company of this city. The result of the work proved conclusively that a small quantity of aluminum freed the steel from blow-holes and increased the tensile strength somewhat without increasing the elongation, besides adding very materially to the fluidity of the bath, thereby producing much sharper castings. It has not yet been determined how small percentages of aluminum are necessary to secure the required products, but from one-tenth to one-twentieth of one per cent. gave satisfactory results. The castings made showed a tensile strength as high as 140,000 pounds to the square inch. The alloy was applied in the form of broken ferro-aluminum. Experiments are now in progress with puddled iron, and when these are completed we hope to give a more definite statement of the results reached.

Fig. 3.



The Cowles Electric Smelting & Aluminum company are now delivering to the Whitehead Torpedo company of London, England, a number of aluminum bronze castings, averaging 1,500 pounds each, and intended for use as air cylinders, being required to stand a pressure of 1,000 to 2,000 pounds to the square inch.

The Tipsy Watch.

By C. K. Giles.

A magnetized watch is a "tipsy watch." It behaves very like a man who is "under the influence." It is "groggy," and can not go straight. Will go sometimes backwards, sometimes forwards, staggers to the right and then to the left, or brings up against a lamp post to make ready for a fresh start, or may sit down on the curb stone and take a rest, as many a fond owner has found to his cost, when he has missed a train, or something more important. A watch loves magnetism as a toper loves his toddy, and will drink it in at every possible opportunity. After it has once got a little, is very susceptible, and will reach out for more, as it were.

The balance wheel and hair spring is the heart, which is very sensitive to the silent forces, vibrates in the influence, and is drawn a little to the right or to the left, trembles a little, hesitates and is lost; throws off the old allegiance, and falls under a new power. This toper of a watch hungers after magnetism, and seeks it out at every turn—it finds it in the atmosphere, and it may be had in intoxicating quantities on the sidewalk, from the dynamo placed there-under to furnish electric light for a block. It is lurking in mischievous quantities in the telephone receiver; it is in every electric light wire, telegraph wire, and in a thousand and one places where least expected—in fact, it is hard to keep a watch temperate and virtuous in the midst of so many temptations. When a watch gets tipsy on magnetism, it does not get over it so easily as a tipsy human his spree, but hangs on indefinitely. A dose of seltzer or bottle of congress will not clean it out. It requires a heroic course of treatment which will change the constitution, and which must be administered in a sort of *allopathic* dose of similia similibus curantur. A watch may be demagnetized, but to be demagnetized *effectively* there must be left in it no residual force, or at least it must be reduced to a minimum. You will frequently hear an engineer say that he can demagnetize his watch by revolving it by means of twisted string before the poles of dynamo—but the watch is not *demagnetized*—only the surplus force is removed. The steel parts of the watch still retain the same intensity of magnetism as the force through which it has passed last. The amount may not be sufficient to stop it, but it will affect the time just the same. The average watchmaker will tell you that *if* the steel parts of the watch do not pick up iron filings, that it is not magnetized. This is a mistake—it is a fatal error—because it throws him off his guard, and he will look for the trouble elsewhere. Very many, if not most of the watches have this residual force strong enough to vitiate time, but not quite strong enough to gather iron filings, or iron dust.

Again, many watchmakers and electricians, to test for magnetism, try their watches by moving a compass needle around them on the outside. This is no test at all and proves nothing. In most cases, the springs in the case of the watch will move the needle of the compass when the watch is lying flat, and will always do so if the watch is held in a perpendicular position. The watch, or any piece of steel material in the watch can be made to move the compass needle according to the position in which they are held, and these pieces may only contain the natural or earth's residual force of magnetism. The best test possible, and practical, that has yet been discovered, is to take a small compass needle, say ¼ to ½ inch in diameter (care being taken to have the needle nicely poised and very sensitive); now pass this little compass needle over the movement, taking each part in detail, and the needle will tell you in no uncertain manner, exactly where the invisible force is hiding. The compass must be held with the fingers (steel must not be used). This test is infallible, and yet simple, and if watchmakers learn to use it more frequently they will, to an extent, reduce the uncertainty as to whether magnetism exists in the watch. This force will sometimes be found to exist only in the hair spring—again, the regulator—but more frequently the balance wheel—there is always more or less in the balance wheel; and then again, the lever or fork may have it. When a watch is thoroughly magnetized, all the moving parts of steel become demoralized, and the watch will be found to be very groggy.

And, still another way of expressing it is this; magnetism in a watch is an unmitigated evil. It may act as a tonic or corrective, and may be just what is needed to brace up the shaky timer, but the right dose in the right place is a difficult thing to accomplish, and like most medicine, the wrong quantity applied in the wrong place does the mischief. Magnetism in watches has always been a malaria resulting in chills and fever, but at the present time it has become epidemic, and as virulent as small pox, but like that disease, may be guarded against by vaccination. Vaccinate your watch with the Anti-Magnetic Shield, and it will be a proof against the disease. This shield corrals and holds sufficient quantity of the earth's induced charge of magnetism to keep within its circle a field of constant polarity, which is equal on all sides, and sufficiently strong to keep the watch from malaria or epidemic disease which may be in its surroundings.

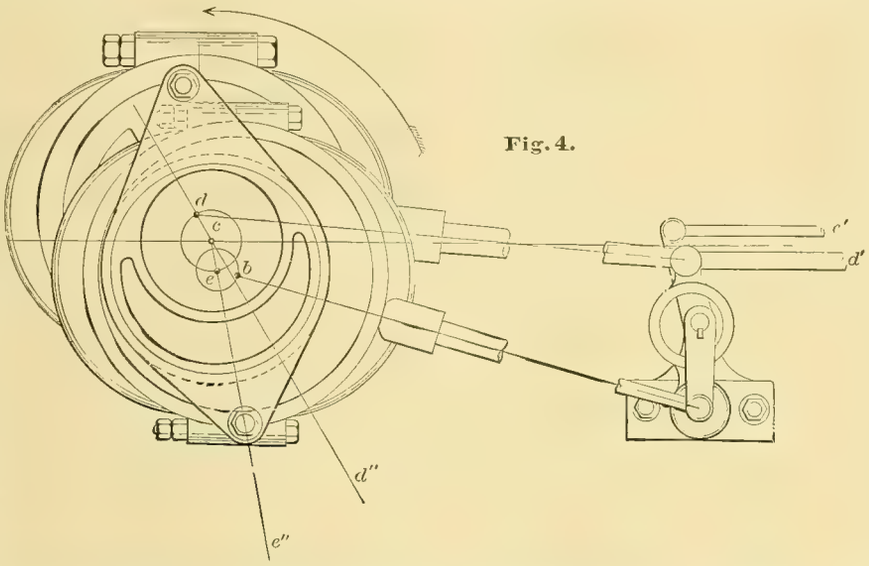


Fig. 4.

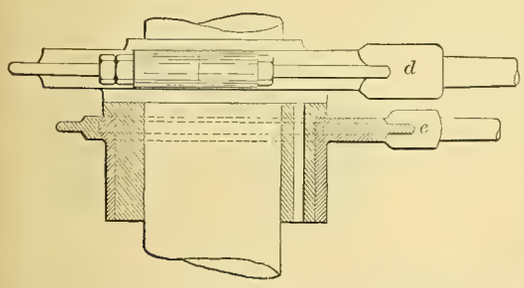
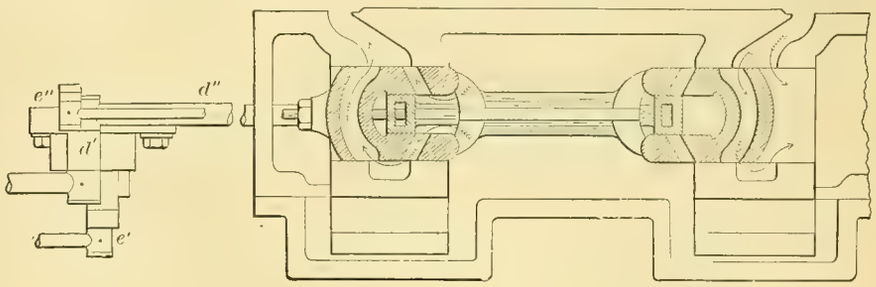


Fig. 5.



New Uses of Electricity.

The history of electricity, remarks a writer in an Eastern periodical, is being made every day. Invention and discovery are comparatively quiet, and no great advance, like Franklin's proof of the identity of lightning and electricity, or Edison's perfection of the electric lamp, has been recently recorded. On the other hand, there is a wonderful activity in the work of extending the uses of electricity. The improvement of methods, the refinement of machines and appliances, and the bringing of science down to daily work and business, moves on so swiftly that the new machine, or the new one of a year ago, is already old. The reduction of refractory ores in electric furnaces, where immense carbons, fed by the largest dynamos in the world, give a heat never used before, excited world-wide wonder only a few months since. The welding of metals by electricity, first performed in Boston this last winter, is already half forgotten in the advance of the science in still other directions. Even the recent railroad accident in Vermont has created a demand for storage batteries for lighting lamps in cars that is so active that every railroad shop in the land is examining new accumulators. Never in the history of any business was there such an eager desire to obtain new machines, new tools, and new methods as in the manufacture of electrical apparatus. In all the fields of electric work, telegraphy, telephonic work, electric lighting, storage batteries, motors and telpherage, there is great activity, but the most remarkable progress is in the last three. The electric light companies have reached a wonderful degree of perfection in their dynamos, but for half of every day their plants are idle. Nobody wants light by day, so it happens great attention has been given in the perfection of stationary motors for power. These motors are small, comparatively light, require very little attention, and once connected by wire with a dynamo driven by a steam engine, will furnish power for manufactures, for running elevators, or for any work commonly given to a steam engine. There is no heat, no coal to be brought to the fire, no ashes, dust, forgetful stokers, or careless engineers. The wire through the wall, turn a switch and the motor is at work, using the same current that lights the street by night. It is not surprising that the whole subject is attracting universal attention, and that almost every week sees the announcement of some improvement in motors or some extension of their usefulness. Their general use in our cities is only a question of dollars and cents. Naturally, this suggested the use of locomotive

motors, and in this field there is the most remarkable activity. Two systems are advanced. In one, the current from the dynamo is sent by wire or the rails to the moving car. In the other, storage batteries charged by a dynamo are carried on the car, so that it is a self-contained locomotive, without heat, dust, smoke or noise—an ideal traveling machine. Telpherage, or the use of moving motors traveling on a wire suspended from posts and dragging trains of small freight cars, is also making remarkable progress, and telpher lines will, no doubt, be soon built in this country. The progress of electricity may thus be noted: No great discoveries of late, but wonderful and rapid progress in its applications to work. The coming helper is the electric motor; the coming convenience is the storage battery that can be carried anywhere to light a house, drive a sewing machine or a boat, or do anything done by the labor of man, a horse, or a steam engine.

Electric Lights for the City.

In the Chicago City Council Wednesday evening, Ald. Clarke called up the ordinance providing for lighting the bridges and viaducts with electricity. He explained that the work would cost about $47,000 if the entire plan was carried out, but for the present it was only proposed to experiment.

Ald. Wetherell made the point that there was no money for the purpose, and claimed that the provision that the expense should come from moneys not otherwise appropriated was illegal and void. He wanted the ordinance amended so that the expense should come from the unexpended balances from fire-alarm, police, and fire appropriations, and the gas fund.

Ald. Clarke thought it would not be necessary to spend more than $15,000 at once, which could be easily gotten from the balances.

Ald. Hamlin made the point that the unexpended balances could not be used as proposed. The appropriations had been for a specific purpose, and if there were any unexpended balances they would have to be carried over and reappropriated in the annual appropriation bill. The money might be taken from the gas fund, but from nowhere else.

After some further discussion the amendment of Ald. Wetherell, in reference to where the money should come from, was amended so as to limit the expenditure to $15,000, and the ordinance was so amended and passed.

The following is the ordinance, except the enacting clause:

SECTION 1. That the commissioner of public works is hereby authorized and empowered to contract for the construction and maintenance of an electric-light system within the limits of the city of Chicago, along and upon the Chicago river and its branches and the bridges, viaducts, and ends of streets contiguous thereto, between Halsted street on the South branch and Halsted street on the North branch, and from those points to the mouth of the river. The commissioner of public works shall designate the route or routes, streets, bridges, tunnels and viaducts in and through which said system shall be extended, and shall have full power to prescribe and enforce all lawful conditions and regulations as to the erection and maintenance thereof. All expenditures under the provisions of this ordinance shall be paid from unexpended balances from the appropriations for fire alarm service, the police and fire departments, and the gas fund, the amount to be not more than $15,000.

Death of A. C. Holland.

The sudden death of A. C. Holland, July 1st, removed from the business circles of Chicago, a young electrician of much promise. Mr. Holland was only twenty-five years of age, but from his early boyhood he had been a student of electricity. It was only a few months ago that he embarked in business and was known as a member of the firm of Johnson, Holland & Co. He was a member of the Chicago Electric Club and anticipated with much pleasure the benefit he expected to derive from association with young electricians like himself and with older electricians of riper experience. He was unmarried; the immediate relatives are brothers and sisters.

How To Make A Leyden Jar.

Any person of ordinary ingenuity and some electric knowledge, who has carefully examined a Leyden jar is very apt to come to the conclusion that it is a very simple thing, and easily made, and if he wants one for amateur work, for his own amusement, or to use in the class room, if he is a teacher, he is quite likely to undertake to make it, and after the expenditure of some money, and a good deal of time and patience, and finding all his experiments utter failures, he either gives up disgusted, buys the article of some dealer, or, patiently investigates the causes of failure, profits by his discoveries, and finally succeeds.

The latter is the true course for the scientist, who has learned from experience that failure to achieve certain expected results leads to reflection, study, investigation and discovery; so that failure of an experiment in one sense is often the highest success in some other sense, the incidental discoveries being often of vastly greater importance than the original object of the experiment.

Such was the writer's experience, some years ago, in his attempt to make a Leyden jar, and this experience during six weeks' persistent effort, and his final success led to very important results, so that he has never regretted the expenditure of time and effort; and it might perhaps be better to say to some amateur "Go thou and do likewise," than to describe the proper method of procedure; but a few lines on this subject may save some one much valuable time, which can be profitably devoted to other important investigation.

The first requisite for a Leyden jar is a glass jar or bottle with a wide mouth. Such an article is apparently very easily obtained, but in 99 cases in 100, is entirely worthless for the purpose, or of very inferior value; and herein lies the chief cause of failure. Nearly all our American glass contains ingredients which so reduce its electric resistance, that it fails when used for electric storage or accumulation, as required in the Leyden jar. This is especially true of fruit jars, candy jars, tincture bottles, packing bottles, battery jars, and similar glass vessels, in the manufacture of which lead, sodium and other conductors or partial conductors, are extensively used, which greatly reduce the electric resistance of the glass. All the nice, clear glass, known as "American flint," is of this variety, and must be avoided.

Indeed it is better to reject all American glass, as very little of it will answer the purpose. The writer has tested a great number of samples of this glass, made at different factories and in different localities, but has never found any whose electric resistance was sufficient for a good accumulator, though some varieties of the green glass have sufficient resistance for an instrument of low grade. Imported glass, on the other hand, has a much higher resistance, and some of the best Leyden jars are made of the imported variety known as "hard flint."

English green glass, such as is used for jars and bottles in which pickles and other condiments are imported, makes the best Leyden jars, and unless some special size or shape is wanted, the shortest method is to purchase such a jar, which can be had at any large grocery, dispose of the contents, cleanse it thoroughly, and it is ready for use.

The remainder of the work is easy; and for this some light tin-foil and good flour paste are the principal requisites. Cut the foil with a shears into strips about two inches wide, and five inches, more or less, in length, according to the height of the vessel. Prepare a strip of wood of sufficient length to reach the bottom of the vessel inside, while grasping the upper end as a handle; make the lower end thin and flat, and about three-fourths of an inch wide, and wrap about two inches of it with soft cotton cloth, securely fastened; and, having pasted a strip of foil, apply it with this instrument to the inside of the vessel, spreading it on smoothly. Cover the inside in this way to within about three inches of the top, and the outside to the same height, and give the uncovered portion a light coat of shellac, and the jar is practically complete. A cap of wood or hard rubber with cork attached, or a common cork, can be used for a stopper, though not absolutely necessary except for convenience. A brass rod through the center of the stopper, terminating about three inches above it in a ball, and below in a light spring or chain, in contact with the tin-foil, will be found convenient for charging and discharging.

Sheet brass or tin can be used for the outside coating, soldered to a circulate brass plate at the bottom, forming a cup, and closely fitted to the jar. If brass is used it can be nickel plated. A jar made in this way is more durable and neater in appearance than with an outer coating of tin foil.

Telephoned Through His Body.

Last Saturday Nelson Crane moved the telephone at Creek settlement from the grocery into John White's sitting-room. Just before he took the wires out of the instrument he telephoned home to his sister, telling her to ring Lower Deposit and talk with that station in about a minute after he spoke to her. The ring for Deposit is three short and one long. Mr. Crane then took the wires from the instrument and held them between the thumb and forefinger of each hand. At the appointed time he received three short shocks and one long one, severe but not painful. Soon after he could feel a very slight, pleasant, agreeable sensation in his fingers clear up to his elbows, and he concluded they were talking. He then put the wires back into the instrument for a moment, and found that his sister at home, a couple of miles distant, had rung Deposit and successfully held a conversation with that station, and it was done all through his body.—*Deposit Courier.*

It may not be generally understood that the telephone bell is rung by a current supplied by a magneto-electric machine, while the current which operates the receiving instrument is supplied by a battery cell, the act of removing the instrument from its hook changing the connection from the bell to the receiver and hence from one mode of transmission to the other, so that the "three shocks" were from the magneto-electric current, while the "agreeable sensation" was from the battery current.

The experiment is of value in showing the high conductivity of a living animal body, which permitted the transmission of a current from a single cell through the arms and trunk, a distance of about six feet, besides the two miles of wire, with sufficient force to operate the distant receiving instrument successfully.

A Norse Tale of the Telegraph.

Nothing will induce a wolf to enter an area which is inclosed by poles connected by cords, and even the telegraph wire has been found to be a preservative against the wolf, says the New York *Telegram.* In Norway, when the first telegraphic line was established by the storthing, one of the members showed himself to be a far-seeing man. He said that his constituents had no interest in the telegraph, but he strongly supported the grant on the ground that the wires and poles would frighten the wolves out of the district. He was perfectly right, and for more than twenty years not a wolf dared to venture within the line of posts and wires.

The Telephone Brings the Bad Out.

"But few people know how much hypocrisy there is in the world," said a young lady employed in the telephone exchange to an Indianapolis *Journal* reporter, "and of that few the persons who have the opportunity to hear the telephone talk of a city the size of Indianapolis may be numbered. There are not many men in business in Indianapolis that I do not know like a book. I am not personally acquainted with more than a half dozen of them, perhaps, but I know just what kind of men they are from hearing them talk over the telephone. I sometimes am horror-stricken at the language used by men who in society and among their fellows are regarded as nice men. I have in mind many prominent church members who sometimes make the exchange girls who have to be listening blush with their talk over the wire. If there is anything bad in a man the telephone seems to bring it out, and a great deal is brought out of many who profess to be wholly good."

The City Lighting.

The Chicago council has decided to go ahead with the river lighting. This will, perhaps, be the entering wedge for a radical change in the entire method of lighting the city. To completely supplant the gas lamps for the whole city would require twelve or fifteen electric plants, and it is estimated that the light now obtained would be given for about forty-five per cent. of the present cost. The city now has about 20,000 lamps, some 3,000 of which burn oil. The cost of maintaining these for the year 1885 was $604,-651. If electric light could be obtained at forty-five per cent. of the present cost of gaslight, provided the city owned the plant, and if fifteen plants costing $47,000 apiece would be sufficient, and Prof. Barrett says they would, then the City of Chicago would save enough in two years by the proposed method to pay for the electric plants, and after that time the cost of lighting the city would be less than one-half what it is under the present system.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations upon some of his specialties:

Chicago	385	400
Central Union	46	47
Michigan	76	77
Great Southern	30	33
Colorado	20	22
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27

European Cables.

There are three different cable lines between this country and Europe, one of them consisting of two parallel cables. This double line, the first laid, one cable being partially placed in 1865, and finished the next year, and the other laid in 1866, extends from Valentia Bay, Ireland, to Trinity Bay, Newfoundland. One of the cables is 2,160 and the other 2,214 miles long. This line does not directly reach the United States but is owned by a company partly English and partly American. The French cable, owned in France, extends from Brest, in that country, to St. Pierre, a small island near Newfoundland, belonging to France, and thence to Duxbury, Mass. It was laid in 1869, and is 3,014 miles long. The line laid in 1874-75, by the Direct Cable Company, an Anglo-American organization, connects Ballinskilligs Bay, Ireland, and Torbay, Nova Scotia, extending thence to Rye, New Hampshire. It is about 3,000 miles long.

The American Institute.

Electricity, in its manifold applications, fills a large and increasing space in the chronicles of these times. The science is worthily represented in this country by the American Institute of Electrical Engineers, which was organized in New York a little more than three years since Its roll of nearly two hundred members, active, honorary and associate, includes most of the famous American electricians now living. The volumes of its Transactions, of which three have been published and a fourth is now in press, may be said to cover the entire field of electrical research for the past few years. The Society is now contemplating the purchase of a building in this city for its permanent quarters. The secretary, Ralph W. Pope, 16 Dey St., states in a circular issued by him that "among the important features of the Institute will be an electrical library, to be continually replenished with new publications; a museum made up of novel electrical apparatus and models, both old and new, to which, if space permits, an experimental laboratory may be added. Suitable accommodations will be provided for council and general meetings and the entertainment of members and their guests, and the house will be open at all reasonable hours. The general plan is to establish an Institute of such repute that it will become the natural custodian of valuable collections of books and apparatus which are now so frequently scattered when their owners pass away."—*Mechanical News.*

ELECTRIC MOTOR.

An effort is being made to secure permission from the city council of Chicago to run an electric motor from Diversey street north, about two and one-half miles. The cable road now being laid will end at Diversey street, and the idea is to extend the road farther north, using the electric motor for power. The system of the Van Depoele Electric Manufacturing Company will probably be used.

The western office of the Sprague Electric Railway and Motor Co., has issued a neat circular designed to bring the merits of the motor to the attention of newspaper proprietors, and showing as points of advantage that it is always ready day or night, that there is an absence of heat, dust and smell, that it gives a uniform speed under all conditions of load, whether one press is running or all, that it is economical of space, that it does not require constant attention by a skillful man, and that it does not necessitate extra in surance. The points are well taken.

The dispatcher speaks very highly of the performance of the Julien electric car on the Fourth Avenue (New York) Street Railroad.

The car ran along with an easy, steady motion and at times attained a speed of twelve miles an hour. It was stopped and started with less of the jar and jerk than the ordinary street car. It was stopped on some of the sharpest curves and heaviest grades on the road and started again with ease. It is said that a car can be run by this motor at a cost of $4.10 a day, while the cost of running a car by horse-power is $7.50.

July 2d, an incorporation license was issued by the Secretary of State to The Richards Elevated Railway Company of Chicago, composed of H. A. Richards, J. J. Healey and F. Ahlschlager, and having a capital stock of $10,000,000, to construct elevated railways in Chicago and vicinity to be operated by steam, electric cable, or other power. It is understood that this company contemplates using electricity as its motive power.

The running of street railways by electricity has proven a success, and street railways all over the country are contemplating a change from horses to electricity. The Van Depoele Electric Manufacturing Co. of Chicago, have equipped eight roads, some of which have been running over a year, and all are making money. The following roads are all running successfully by the Van Depoele system: Capital City Electric Railway Co., Montgomery, Ala, 13 miles—20 cars—8% grades; Dix Road, Detroit, Michigan, 2 miles—2 trains of 6 cars—2% grades; Appleton Electric Railway, Appleton, Wis., 4 miles—5 cars—8% grades; Windsor Electric Railway, Windsor, Ontario, 2 miles—2 cars—2% grades; Scranton Suburban Railway, Scranton, Pa., 4 miles—5 cars—7% grades; Port Huron Electric Railway Co., Port Huron, Mich., 4½ miles—4 cars—3% grades; Binghamton Electric Railway, Binghamton, N. Y., 5 miles—7 cars—6% grades; Lima Street Railway, Lima, Ohio, 4 miles—3 cars—2% grades. The cars run from six to twenty miles an hour, as desired. Roads are being equipped under the Van Depoele system at Ansonia, Conn., St. Catharine's, Ont. and Brooklyn, N. Y.

A SPECIAL from Oil City, Pa., says: In the Oil Exchange to-day Mike Keating failed. Keating is but twenty-four years old. Early in the summer of 1882 young Keating than nineteen years of age, was a messenger in the Western Union Telegraph office in that city. It was well known in Oil City at the time that he speculated in a small way in oil, through another party, he not then being old enough to become a member of the Exchange. It was said that he interpreted the cipher dispatches of some of the heavy operators, and speculated on the knowledge thus gained. At all events he rolled up a fortune of $60,000 that summer, and he was still under twenty years of age. Then he took a pleasure trip to Cleveland, Chicago and other cities, leaving most of his fortune in the hands of his friends to manipulate for him.

The friend operating on his own judgment, and at the same time doing what he thought best for the boy, played the bull side of the market and lost. Mike returned to Oil City almost penniless. At the age of twenty-one he became a member of the Exchange, and has ever since carried on a brokerage business. He says he will make up his failure and begin over again.

ELECTRIC LIGHTING.

The following lately appeared in the Chicago *Tribune:*

Gas is no longer to be thought of in lighting a city of the energy and progress of Chicago. The electric light should not only be used for the lighting of the bridges and rivers, but it is high time it should be extended throughout the entire city. It is no longer an experiment. Have you ever seen a city properly lighted with brillant electric lamps? Chicago is behind the age in light, as may be seen by visiting other cities. St. Paul and Minneapolis are pretty well lighted by electricity, but half of their light is wasted by being placed on poles at the sides of the streets. New Orleans is a beautifully lighted city, the result being brought about mostly by the eager, grasping gas monopoly. The gas company refused to light the streets for the price the Council would pay. Consequently for many weeks while I was there not a gas-lamp was lighted, and the streets dependent on gas were in darkness. Now New Orleans has miles upon miles of brilliantly electric lighted streets. The levee along the river is lighted for miles, and the crescent shape can be traced by the electric lamps. Canal street, St. Charles avenue, and I can safely say forty of its streets are lighted, not with candles or gas, but good, bright electric lights, not for a few blocks, but in many cases the entire street, five and six miles in length. Many of the streets are lighted with arm brackets, which hold the lamps in the centre of the street or centre of the crossings, and are very easily swung down. In this way the street gets the full light and none is wasted.

Everybody knows how Chicago is lighted (or not lighted), and for the money expended it is a shame that this city, of all others, should be so backward. Light is the most needed thing in Chicago to-day. Let us all support the Mayor and ask the Council to not only light the bridges and river, but all the principal streets.

Applications have been filed with the board of trustee by the Hyde Park Electric Light Company, and the Burdett and Loomis Gas and Electric Light Company for permission to build and operate an electric light plant throughout the village of Hyde Park; considerable capital is backing the enterprise.

Marshall Field's mammoth new wholesale dry-goods house is well equipped electrically. It has 180 arc lights, mercurial fire alarm, and electric call bells and signals throughout the building. The Western Electric Company supplied all of the electric apparatus.

According to the New York correspondence of the Chicago *Herald* at the recent annual meeting of the American Electric Manufacturing Co., the report of the treasurer, Col. Wm. A. Stedman, showed that the earnings of the company were $112,677 over and above two quarterly dividends that had been paid during the year.

Theo. P. Bailey, special agent of the Thomson-Houston company, with headquarters at Kansas City, was in town this week. Mr. Bailey's territory comprises Kansas, Missouri and Nebraska. Since last October, Mr. Bailey has put nine hundred arc and fifty-six hundred incandescent lights in his territory, and a late sale is for sixteen hundred more incandescents.

The Sperry Electric Company has just been incorporated.

The Brush Electric Company, through Alexander Kempt, special agent at Chicago, have just closed a contract with parties in Fort Madison, Iowa, for two 30-light arc dynamos and one 450-light incandescent dynamo.

Fergus Falls, Minn., will soon have their electric light plant in operation. They will use the Heisler system of long distance incandescent light.

The St. Louis exposition, which opens September 7th, and continues until October 22d, will be lighted by one hundred or more arc lights of the Western Electric system.

NEW ENTERPRISES.

Dexter Thurber, of Minneapolis, Minn., will erect a handsome residence, to cost $10,000. It will be provided with all the latest improvements and will be fitted with electric bells.

C. G. Baldwin, of Sioux City, Iowa, is the architect of a handsome residence that Craig L. Wright, of the same place, is to build at a cost of $6,500.

The Northwestern Casket Co., of Minneapolis, Minn., are about to build a factory to cost $20,000.

W. L. Churchill, of Alpena, Mich., is rebuilding a large hotel.

A. A. Cooper, of Dubuque, Iowa, is erecting a handsome three-story residence at a cost of $50,000. Electric appliances will be wanted. T. D. Hyde is the architect.

Col. A. M. Saxton is erecting a seven-story hotel at St. Joseph, Mo., at a cost of $180,000. Eckle & Man are the architects.

Bartley Cooper is building a store and flats at Minneapolis, Minn. The estimated cost is $12,000. Electric bells will be wanted.

E. & F. F. Curtis, of Minneapolis, Minn., are building two residences, one at a cost of $7,000, the other $8,000.

Shirk & Miller, of Peru, Ind., are erecting a building to be used as a bank and stores; cost, $30,000.

A. A. Ainsworth, of Larned, Kan., is erecting a business block, the cost of which will be $20,000.

S. S. Sprague & Co. are putting up a three-story building in Minneapolis, Minn., to cost $13,000.

Jerabeck & Totuscheck, of Silver Lake, McLeod Co., Minn., are erecting a new flour mill.

A. H. Hill, of Austin, Minn., is rebuilding a store that was recently burned. The cost will be about $4,000.

A Baptist college is contemplated at Ottawa, Kan.

W. M. Donaldson, of Minneapolis, Minn., is erecting a residence at a cost of $6,000.

S. G. Cook & Co. will erect a $10,000 addition to their elevator at Minneapolis, Minn.

Schulte & Nehring are building a factory at Evansville, Ind., at a cost of $15,000.

The Lutheran society at Kansas City, Mo., will build a parsonage at a cost of $8,500. It will be provided with electric bells.

The Metropolitan Street Railroad Company, of Kansas City, Mo., are building a new engine-house at a cost of $45,000.

THE TELEPHONE.

Central Union Telephone Co., June 29th, declared a quarterly dividend of $1.25 per share. The dividend is payable July 20th, and the transfer books will be closed July 15th. Central Union has been a four per cent. dividend stock, but this dividend advances it to a five per cent. stock. Stockholders should certainly feel encouraged at this indication of increasing prosperity.

The Central Union's last quarterly dividend was $1.25 per share. This is an increase at the rate of one per cent. per annum over the usual dividends paid lately.

Since the publication of the article in this journal illustrating the Western Electric company's speaking tube telephone system, the company has received two orders for this apparatus; Chicago Rock Island and Pacific Railroad Company, outfit for 20 stations for their new office building in this city, and outfit for 30 stations for Marshall Field's new wholesale store.

The Bell Telephone company of Canada, have just ordered two miles of 50-wire aerial telephone cable of the Western Electric company.

The telephone exchange of Copenhagen, Denmark, has placed an order with the Western Electric Co. of Chicago, for a multiple switch board, 4,000 capacity and 1,200 equipment.

Personal Paragraphs.

W. P. Noble, who will assist W. H. Brenner of Cincinnati, O., in installing the Edison station in the Mikado's palace at Tokio, took the steamer at Victoria July 6th.

Prof. J. P. Barrett, city electrician of Chicago, completed his twenty-fifth year of service to the city on the 2d inst.

THE TELEGRAPH.

The following are the officers of the Toledo, O., division of the order of railway telegraphers: Chief telegrapher, A. W. Brant; past chief telegrapher, J. C. Harriman; assistant chief telegrapher, Fred Marshall; senior telegrapher, W. H. Young; junior telegrapher, E. G. Benskin; inside guard, H. W. Ellinghouse; outside guard, C. J. Hickox; secretary and treasurer, A. W. Meader.

The Chicago factory of the Western Electric Company has been working twenty-one and one-half hours a day for seven months, and yet has not been able to keep up with the demands made on it. The company have decided to build an addition and propose to expend about $75,000 on it. New machinery will be added and a number of departments now overcrowded will be relieved.

Business Mention.

The Hercules Iron Works have just placed second order with Jarvis Eng. Co., 81 Lake St., for one 5x16 and one 5½x18 boiler to be set on Jarvis furnace at San Antonio, Texas.

The White Line Railroad, of Dayton, Ohio, has placed an order with the Van Depoele Manufacturing Company, of Chicago, for eight cars. Six of the cars are to be provided with motors.

Carbons.—The business formerly conducted by E. C. Hawks, agent, will hereafter be conducted by the United Carbon Companies, office, room 90, Wilshire Building, Cleveland, O., who will endeavor to serve the electric light people to the best of their ability at all times. All communications should be addressed as above.

The Western Electric Co. have received an order for two multiple switch boards from Cleveland—one for the central office and the other for a branch exchange. The one for the central office has an equipment of 1,800. The same company has also taken an order for 4,000 feet of cable for Denver, Col., and an order for a 200 drop annunciator for White Sulphur Springs, Montana.

Some weeks ago the Van Depoele Manufacturing Company shipped four cars with electric motors to Lima, Ohio. The cars were delayed on the road and car-burglars seized the opportunity to rob the motors of nearly all the brass work on each motor. The financial loss amounted to about four or five hundred dollars. The most annoying feature, however, was the delay in starting the system. It was expected to have the cars running by the 1st inst.

The Hill Clutch Works of Cleveland, O., who have recently thoroughly equipped their plant for the manufacture of the well-known Hill clutch under the personal supervision of the inventor, H. W. Hill, report that they are full of orders. They have just closed a contract with the Minnesota Brush Electric Co., of Minneapolis, for putting in their entire plant, which is to have 2,000 horse power of engines and 28 sixty-five light Brush dynamos. The contract was taken against seven competitors and was awarded by a committee of expert engineers. The company is to be congratulated on the achievement.

A very neat and complete catalogue is that just issued by the Central Electric Co., 38 and 40 La Salle street, Chicago. It numbers 350 pages and covers a vast variety of electrical instruments. It is profusely illustrated with fine cuts, and is so full of information that it makes a choice addition to a library. All kinds of supplies for telegraph, telephone, electric light, dental, medical, and a host of other purposes are shown, in addition to testing instruments of all kinds; in fact, it may be said that almost any electrical appliance desired can be found within the covers of this book. Copies can be had by addressing the company.

The Western Electric Company, Chicago, New York, London and Antwerp, has just issued a new general catalogue illustrating and describing their manufactures. The list is a large one, and includes, among other articles: Telegraph instruments and apparatus; telephone instruments and apparatus; aerial, underground and submarine cables for telegraph, telephone and electric light uses; apparatus for electric lighting, annunciators and electric bells; electro-mercurial fire alarm apparatus; testing apparatus; electro-medical apparatus; batteries, and a long line of miscellaneous apparatus. The catalogue contains a fund of information, and in addition is very handsome typographically. It will be sent to any address upon application.

"Good-bye, mules." This is the parting kick—at a safe distance—the Montgomery *Advertiser* of the 23d ult. makes at the abolition of mule power on the street railway system of Montgomery, Ala., which has been superseded by the electric motor system of the Van Depoele Manufacturing Co.'s make. The article, descriptive of the system, continues: "It is all a grand and glorious success. The whole system, the four lines, come together on Court Square and go down Commerce street on a double track to the depot. There is no halting at switches, but the cars go down on one track and back on the other. The whole system represents an actual expenditure of $175,000 in cash."

Mr. W. A. Stiles, secretary and treasurer of the Van Depoele Electric Manufacturing company, gave the following interesting talk in a recent interview with a city paper:

"The running of street railways by electricity has proved a grand success, and street railways all over the country are contemplating a change from horses to electricity. The Van Depoele Electric Manufacturing company, of Chicago, has already equipped eight roads, some of which have been running over one year, and all are making money."

"Will you name the cities in which your company have placed electric motors for this purpose?"

"The Capital City Electric Railway company, of Montgomery, Ala., thirteen miles in length; twenty cars, with eight per cent. grades. The Dix road, Detroit, Mich., two miles; two trains of six cars each, two per cent. grades. The Appleton Electric railway, Appleton, Wis., four miles; five cars, eight per cent. grades. The Windsor Electric railway, Windsor, Ont., two miles; two cars, two per cent. grades. Scranton Suburban railway, Scranton, Pa., four miles; five cars, 7 per cent. grades. Port Huron Electric Railway company, Port Huron, Mich., four and one half miles; four cars, three per cent. grades. Binghamton Electric Railway, Binghamton, N. Y.; five miles, seven cars, six per cent. grades. Lima Street Railway company, Lima, O., four miles; three cars, two per cent. grades."

"The cars on these roads run from six to twenty miles per hour as desired. In addition to these roads, we are equipping, under the Van Depoele system, electric railways at Ansonia, Conn., St. Catherine's, Ont., and Brooklyn, N. Y."

"What is the cost of running street-cars by your system as compared with horses?"

"There are over one hundred thousand horses used in handling street cars in the United States—Chicago having nearly nine thousand. Five years is more than the average useful life of a horse for street-car purposes. We have thoroughly demonstrated the fact that cars can be run by electricity under the Van Depoele system for one-half the cost of horses, with coal figures on the basis of $6 per ton."

"How would the Van Depoele system work on the proposed elevated railroad on State street, for instance, say from Van Buren street to Hyde Park?"

"It would be simply perfect. The wires carrying the motive power would be placed on the trestle-work, or over the top of the cars, and could be used for all purposes, lighting, heating, and motive power. There could be no objectionable features whatever, and, as *The Times* said editorially, cities that have but a fraction of Chicago's wealth and population easily secure the investment of adequate capital in elevated roads, electric motors, and appliances for street transportation adapted to their needs. How much longer must the people of this greatest of western cities wait for the advent or awakening of enterprise enough to undertake the substitution of modern facilities for the methods of antiquity still employed in the business here?"

There is now no question at all as to the part that electricity will take in connection with railways. The experimental stage has been passed, and nothing now remains but the practical fact of its application.

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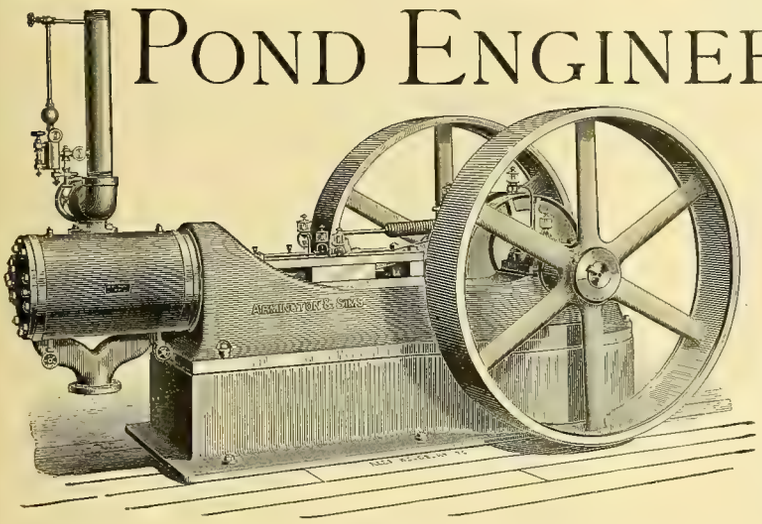

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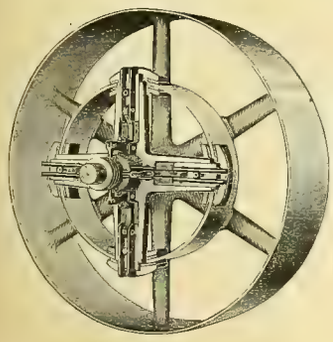

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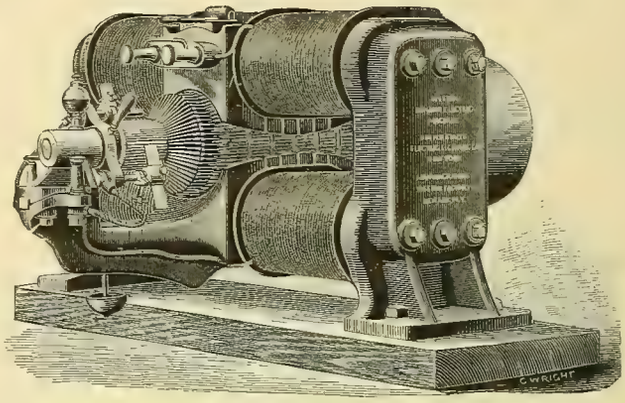

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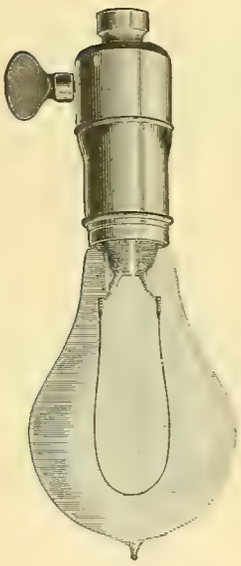

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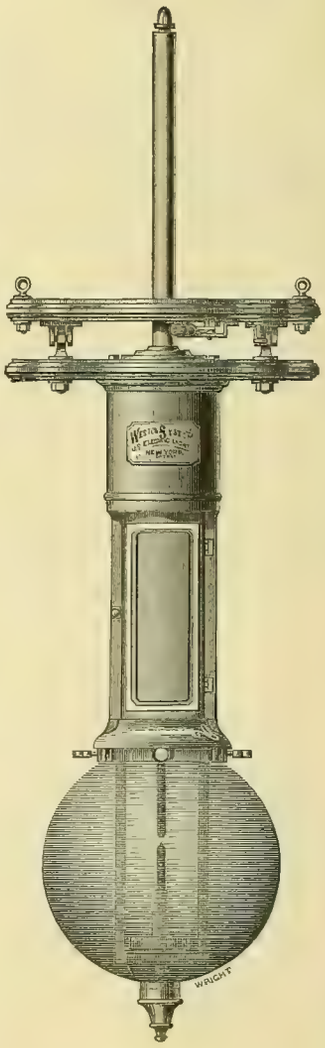

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2nd.	" " 20 " " " " " "	8
3rd.	Life " 16 " " " guaranteed,	600 hours.
4th.	" " 20 " " " "	1000 "
5th.	Percentage of discoloration of lamps at or near end of guaranteed life,	inappreciable.
6th.	Self Regulation of Dynamos to insure even burning of Lamps,	yes.

C. C. WARREN,

MANAGER WESTERN DEPARTMENT.

216 La Salle Street, CHICAGO.

Territory:—Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Arkansas, Kansas, Nebraska, Colorado, Dakota, Idaho, Montana, Utah, New Mexico, Texas, etc.

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THE

Van Depoele Electric Manufacturing Co.

OF CHICAGO, ILL., U. S. A.

OWNERS OF THE PATENTS AND INVENTIONS OF CHAS. J. VAN DEPOELE.

FOR

ELECTRIC RAILWAY APPARATUS,

Electric Arc Light Dynamos and Lamps.

CONSTANT SPEED STATIONARY ELECTRIC MOTORS, ETC.

OUR

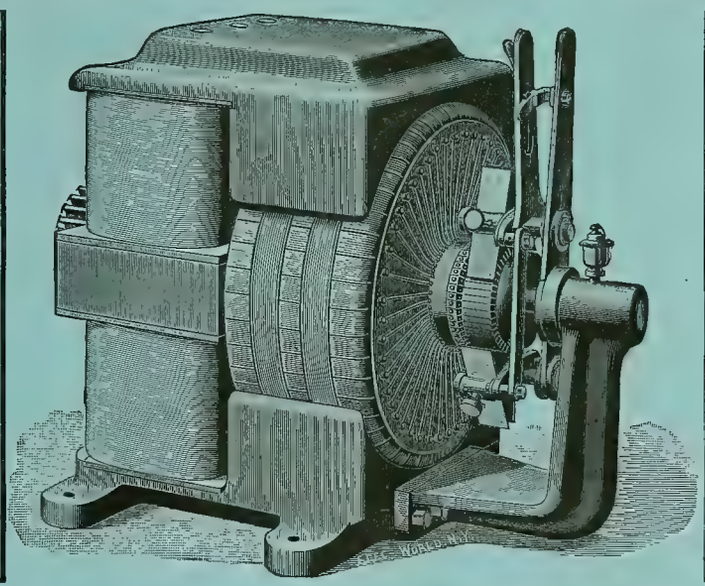
Electric Light

UNEQUALED.

The Only Perfect Double-Lamp.

THOUSANDS IN USE.

Guaranteed equal to any in every respect.



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Electric Railway

SYSTEM

PROTECTED BY

BROAD PATENTS.

The Overhead Wire and Underground Conduit Systems Fully Protected.

Van Depoele Electric Railways

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Appleton, Wis, Scranton, Pa., Montgomery, Ala., Detroit and Port Huron, Mich., Windsor, Ont., Binghamton, N. Y., and Lima, O., and are being constructed at Ansonia, Ct., and Brooklyn, N. Y.

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VAN DEPOELE ELECTRIC LIGHTS

Are in use everywhere and are daily growing in popularity.

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Broadway and P. Ft. W. & C. Ry.
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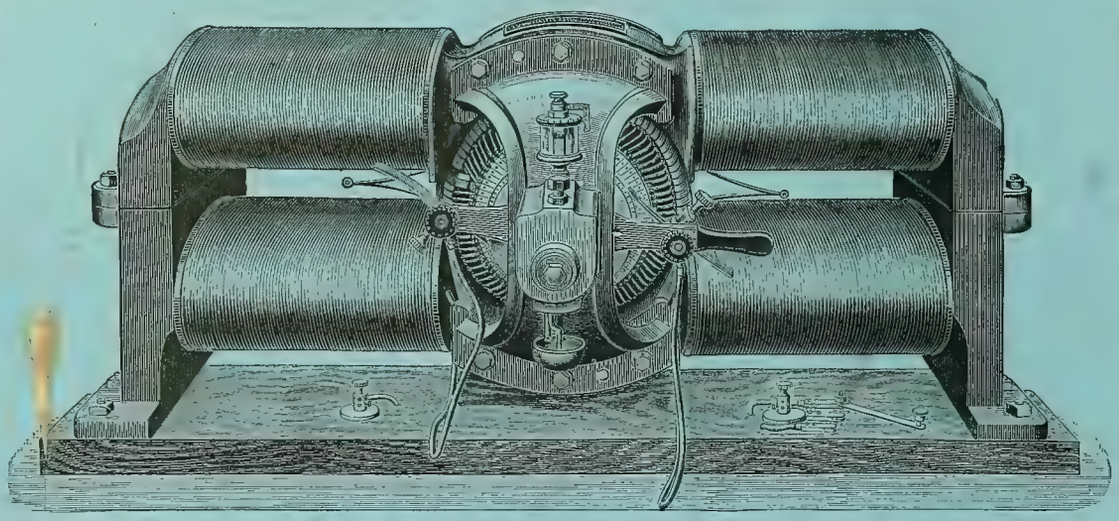

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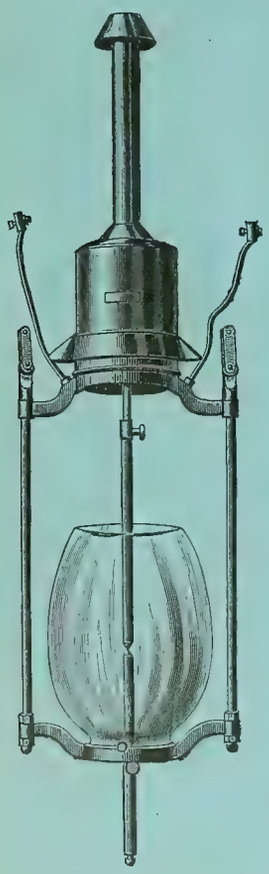

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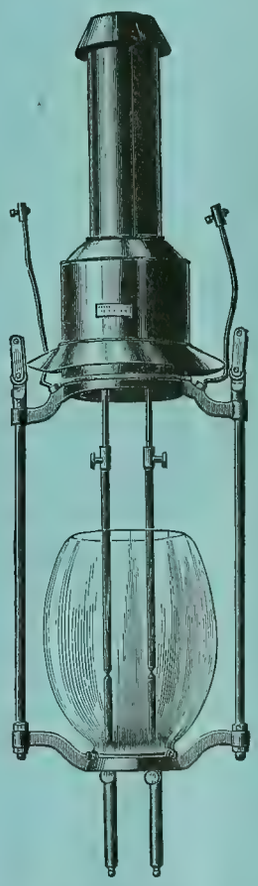
—AND THE—

Perfectly Automatic and Self-Regulating

JENNEY ARC LIGHT



The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

ONLY GOLD MEDAL

At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

This system HAS NO EQUAL for SIMPLICITY, DURABILITY and STRENGTH OF LIGHT.

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The filament is as pliable as a piece of thread and is not made brittle by the action of the current.

Complete System of Fixtures and Attachments, also full line of Electroliers, Combination Fixtures and Shades.

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Vol. I. CHICAGO, JULY 16, 1887. No. 3.

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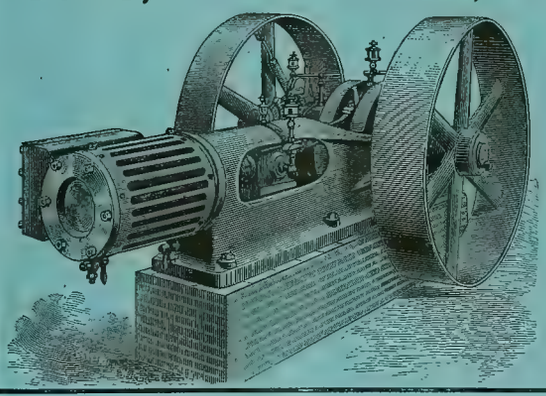
Specially Adapted for Electric Lighting.



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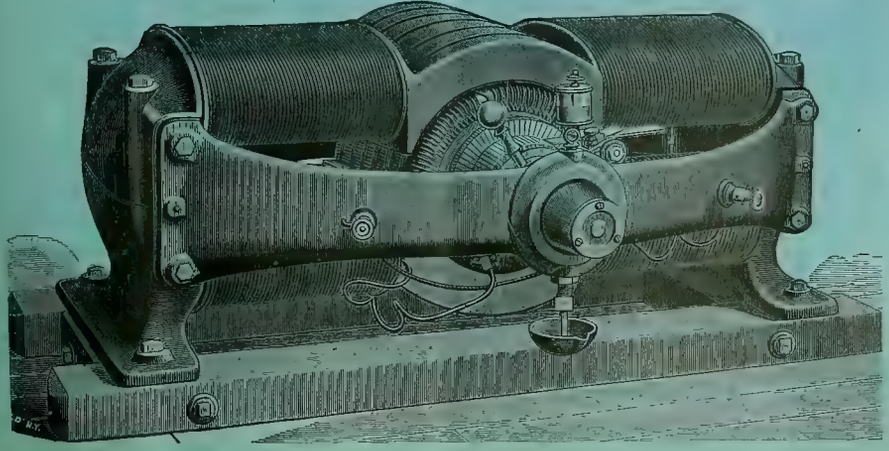
JENNEY ELECTRIC COMPANY,

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

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SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

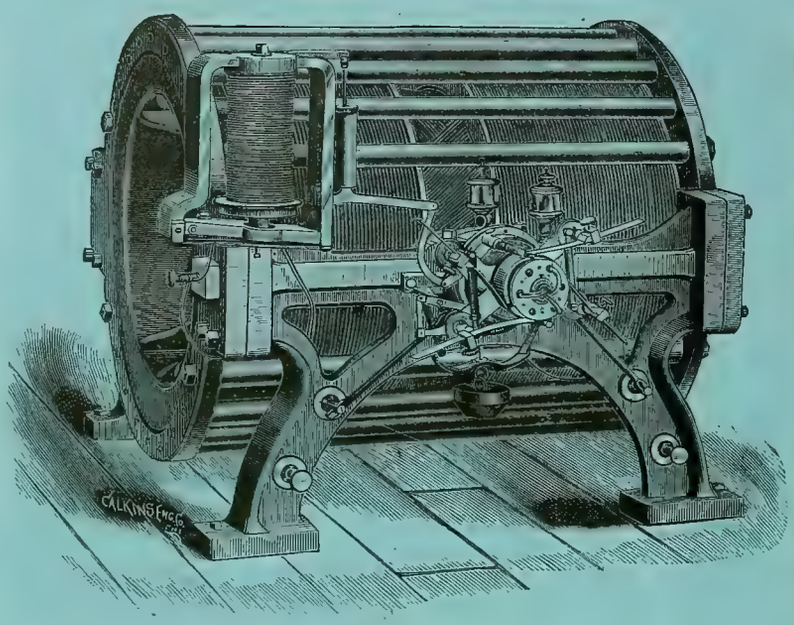
OF

Electric Arc-Lighting

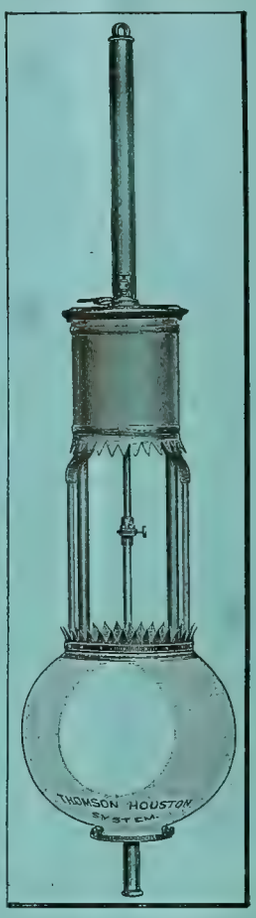
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

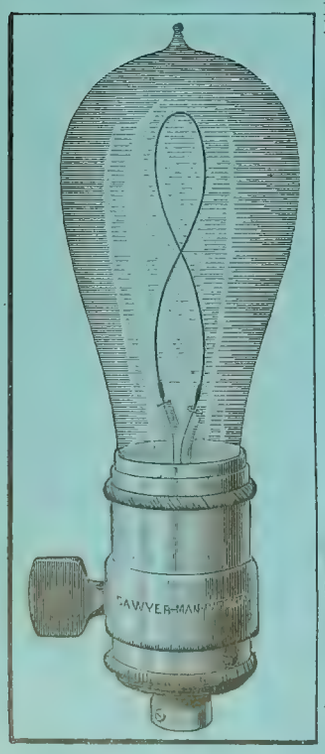


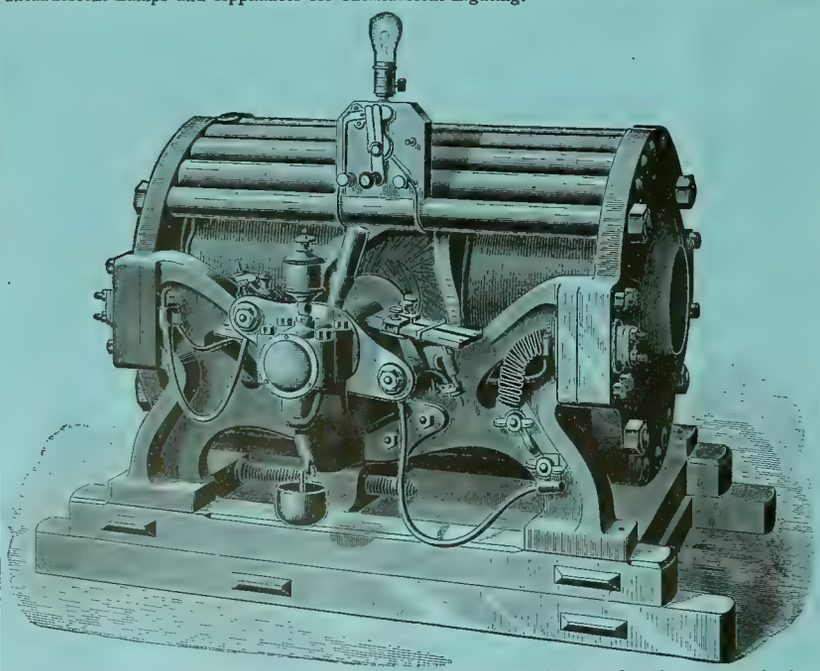
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





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Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

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AMERICAN SYSTEM

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(WOOD'S PATENTS), Owned and Manufactured by the

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18 Cortlandt Street, NEW YORK.

For Simplicity of Construction, Steadiness and Purity of Light, Perfection of Automatic Regulation, Economy of Power in Operation, Freedom from getting out of Order, and Absolute Safety of Armatures from Burning,

THE AMERICAN DYNAMO HAS NO EQUAL

INTENDING PURCHASERS,

Whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

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REYNOLDS' IMPROVED CORLISS.

THE IDEAL ENGINE FOR ELECTRIC LIGHT WORK.

Unequaled for Close Regulation

—AND—

ECONOMY OF FUEL.

Write for our Catalogue and Circular giving List of Users.

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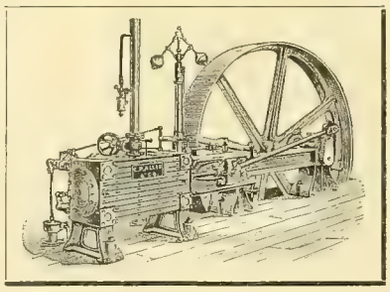

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Brush Electric Light and Power Co., Cleveland, O.
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Badger Illuminating Co., Milwaukee, Wis., two engines.
West Side Power Co., Minneapolis, Minn., four engines.
Louisville Electric Light Co., Louisville, Ky.
La Crosse Brush Electric Light and Power Co., La Crosse, Wis.
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Sioux Falls Electric Light and Power Co., Sioux Falls, Dakota.
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EDW. P. ALLIS & CO., RELIANCE WORKS, MILWAUKEE, WIS.

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FOREST CITY ELECTRIC WORKS,

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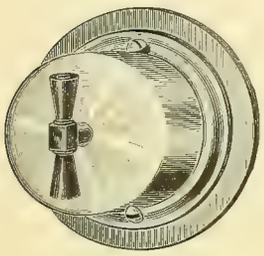

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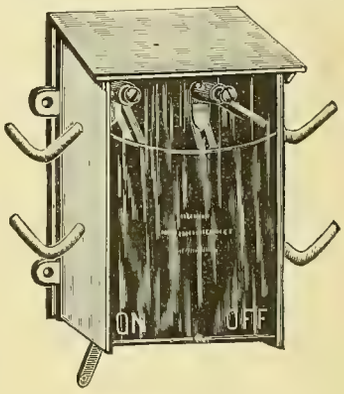

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EXCLUSIVE MAKERS OF

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Pins, Brackets, at special low prices. In stock, full line Iron, Steel and Hard-drawn Copper Wire, Batteries, Gas Lighters, Call Bells, etc., etc.

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SPECIALLY ADAPTED FOR RUNNING

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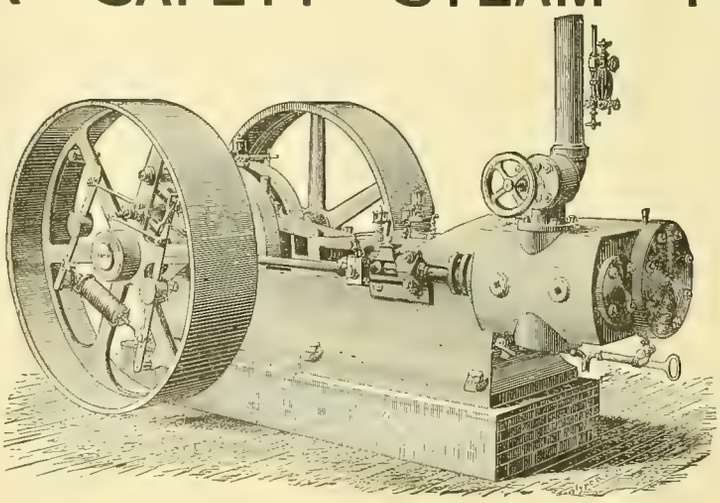
And other duty requiring close regulation of speed.



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Small space required.
Simplicity of construction.
Accessibility of all parts.

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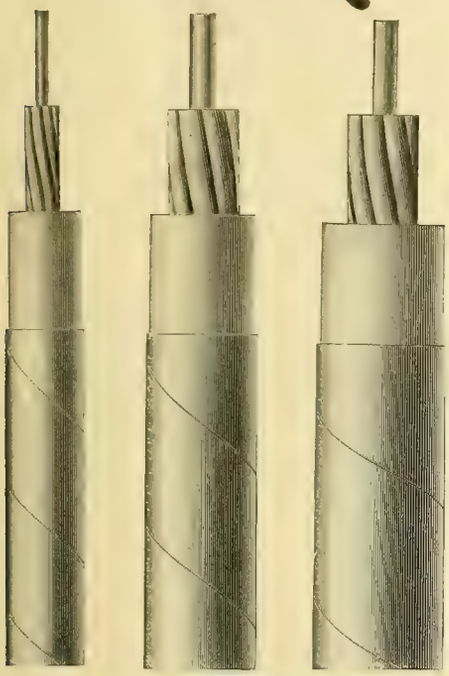

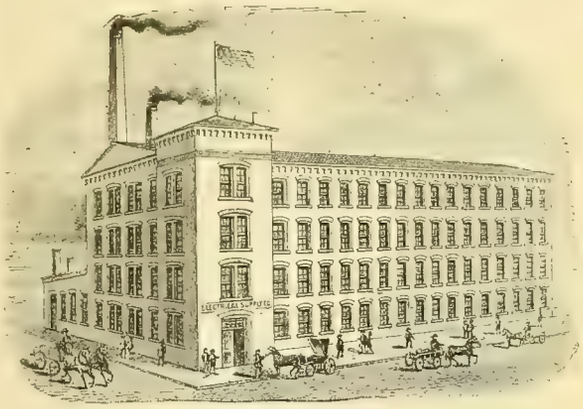

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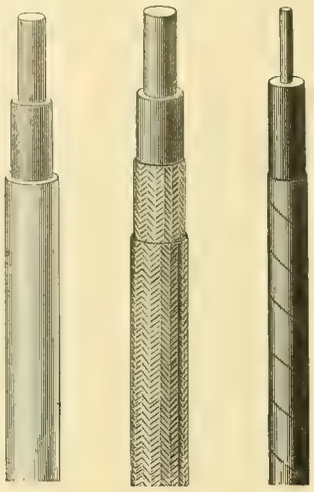

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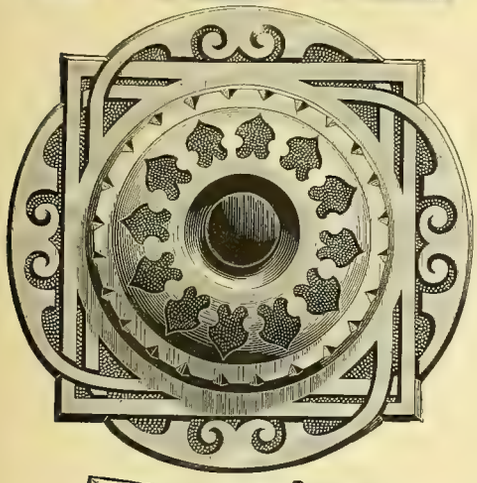

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Bells, Batteries.

WIRES,

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CABLES.

AMMETERS,

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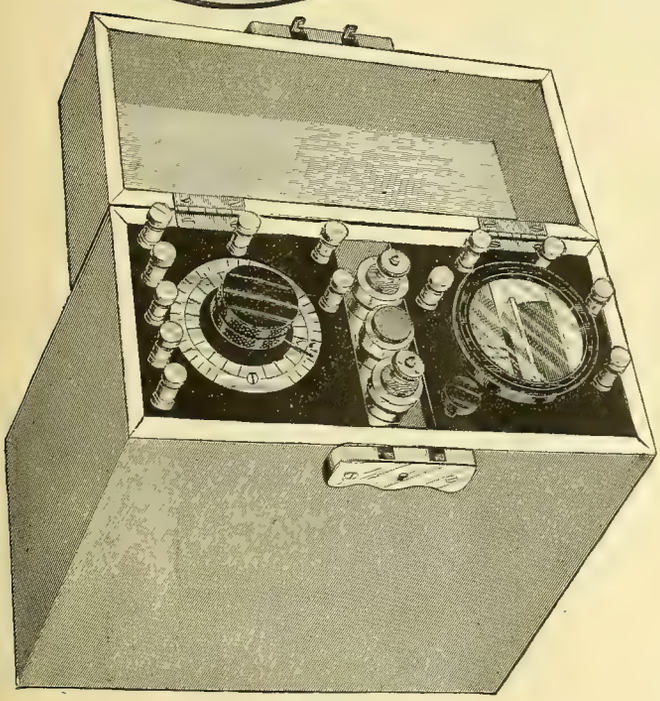

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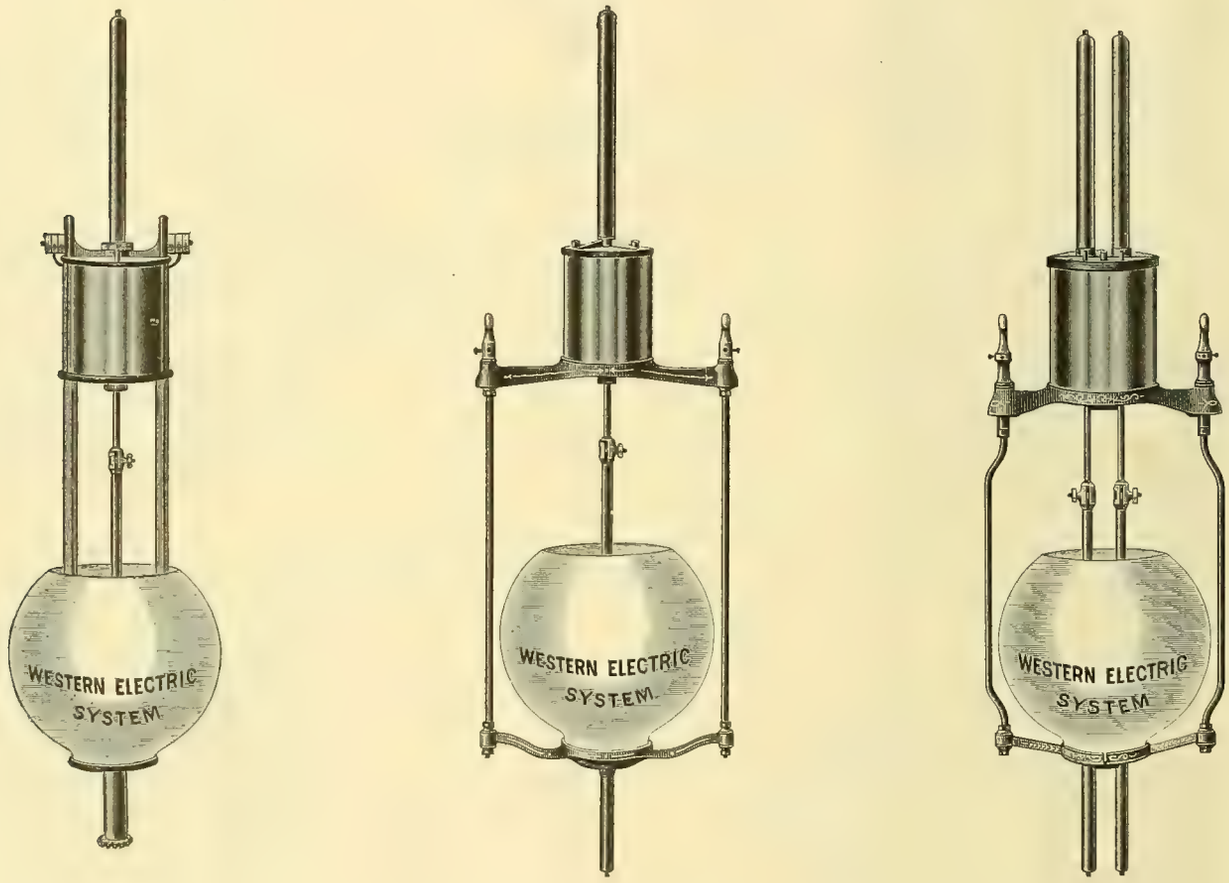
THE WESTERN ELECTRIC COMPANY'S

SYSTEM FOR **Arc Lighting** Is Perfect in Every Detail



Incandescent Lamps, if required, may be run practically and economically on the same circuits with our Arc Lamps.

A NEW EDITION OF OUR ILLUSTRATED GENERAL CATALOGUE IS READY FOR DISTRIBUTION.

SEND FOR A COPY.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, JULY 16, 1887. No. 3.

Cook County Hospital Plant.

The illustrations herewith show the electric light plant of Cook County Hospital, put in by the United States Electric Lighting company. The merits of this company's system of incandescent lighting are too widely known to demand much consideration. Suffice it to say that the system combines first-class electrical and mechanical design with great efficiency and economy of operation. All the devices necessary for the completeness of the system are not only extremely practical, but also elegant in design and workmanship, and in their present form are the result of over six years varied experience in the erection and operation of incandescent plants.

The mechanical arrangement of the plant has much that will interest those engaged in installing such plants. There are a total of 1,300 sixteen candle power lights, which are supplied by four 200-light dynamos. Fig. 1 shows the dynamo room with the four dynamos belted to pulleys on one shaft. The engine seen at one end of the shaft is a 100 horse power Ide engine with a cylinder 13 inches diameter by 18 inches stroke, the fly wheel having a speed of 225 revolutions. The pulleys from which belts run to the dynamos are 72 inches diameter, and the pulleys on the dynamos are 14 inches diameter. The pulleys on the main shaft are friction clutch pulleys, which enable the engineer to throw any dynamo into operation at any time or vice versa. A tightener is seen under each belt. This is designed to take up any slack in the belt, and at the same time give the belt closer contact to both driving and driven pulleys.

Each dynamo has a current indicator showing the number of lines in use, thus enabling the engineer to throw in any number of dynamos in proportion to the load. The potential indicator at all times shows the electrical pressure, and a ground detector shows the condition of the lines at all times.

There are eleven different buildings connected with the hospital that are lighted by this system, the lights being spread over an area of about 1,500 feet by 1,000 feet. The brass fixtures for the lamps were designed for the place, and are very handsome and artistic. The whole plant was installed in the very quick time of two months.

As a means of illuminating an institution of this character, the incandescent light stands without a peer. It is steady, does not burn the oxygen out of the air, causes no heat, and is ready at any time for immediate use. The patients and physicians at the hospital are exceedingly well pleased with it. Provisions have been made for attaching hand lamps, which in cases of surgical operations or of dissection, can be placed exactly where they are needed without, in the case of an operation, causing any discomfort to the patient, or interfering with the movements of the attendant surgeons.

Fig. 2, on the succeeding page, shows the form of the lamp of this system. Fig. 3 is an illustration of the ammeter, and fig. 4 shows the potential indicator.

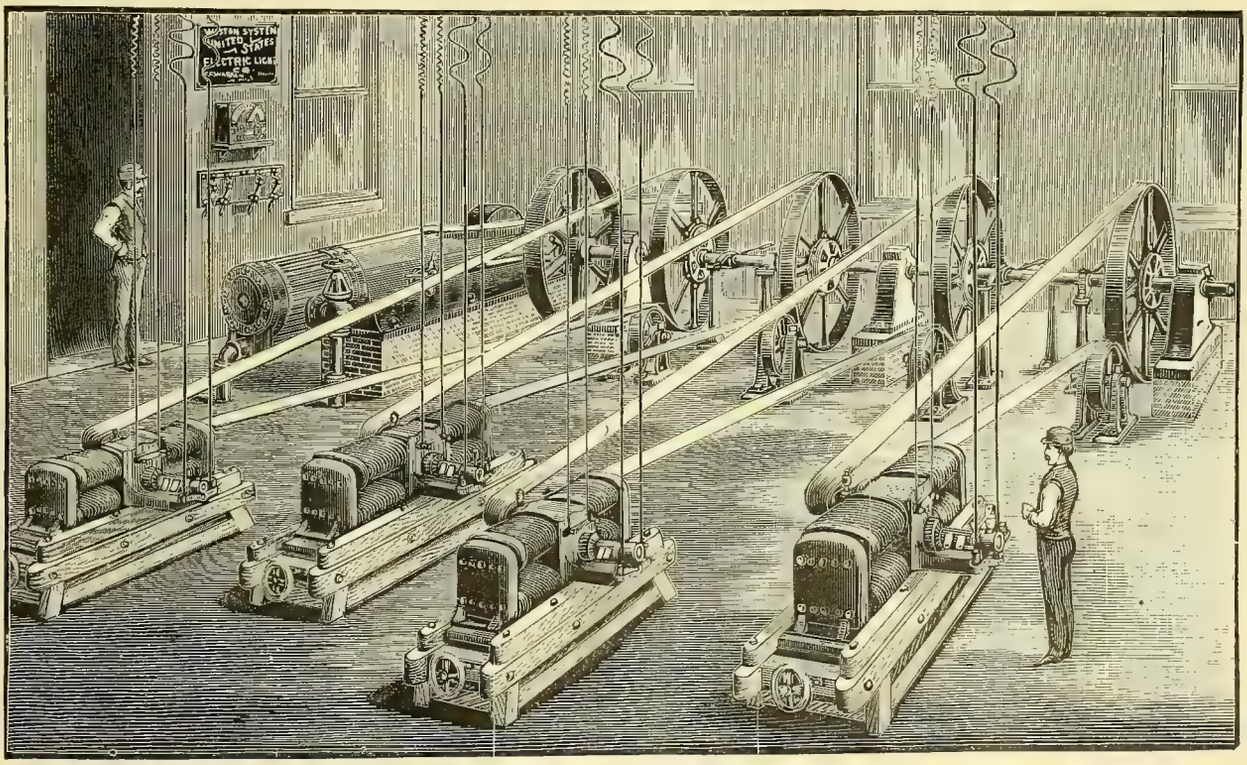


Fig. 1.—Cook County Hospital.

The Chicago Fire Alarm System.

The operating department of the Chicago city electrician's office is a place of great fascination to those interested in electrical matters. The city electrician has under charge the electrical equipment of the fire alarm telegraph, the police signal service, the circuits that connect the mayor's office and the various police courts with the house of correction, the water line service, the board of health, which has a separate telephone line, the telephone line connecting the river bridges, the electric light plant of the city building and the two tunnels, and the telephone and signal system of the board of public works. The main work of the department naturally is the handling of the fire alarm telegraph, and in this branch the completeness and thoroughness of the system are such as to demand admiration.

At present there are 557 fire alarm boxes scattered throughout the city, but in the course of two months this number will be increased to 610. These boxes are placed in twenty-five different circuits, which terminate in the office. Each circuit connects with an annunciator, the drops of which disclose the number of the circuit that is brought into use for any reason, and also with a single vibratory bell and with an ordinary key and relay. When a box is pulled the vibrating bell gives its warning whirr, and the drop on the annunciator shows on which circuit the alarm is coming in. If the alarm is coming clearly and distinctly, as the operator can tell from the relay, the engine house circuits are switched in by hand, and the alarm is given there, both on gongs and on the registers which print the number of the box on a tape of paper. The operator's duty is hardly begun yet, even though the engines whose duty it is to respond to any particular alarm are on their way. After the number of the box is given the various houses, the operator sets the hands on the dials of a large manual repeater, and the thirteen city bells warning the public of the progress of a fire begin to toll out the number

The fire department proper consists of forty-one steam fire engines, including two fire-boats, thirteen hook and ladder companies, and as many one-horse chemical extinguishers. To each alarm five engines, two truck companies, and two extinguishers respond, as well as two battalion chiefs or marshals. If the fire is an unimportant one, this force is amply able to cope

with it, but in no small number of cases, especially in crowded business districts, a reinforcement is needed. Here is where the utmost care and attention of the operator in charge is demanded. It may be ten minutes or half an hour or even more after the alarm is sounded, when one of the marshals at the box nearest the fire signals for more help. Meanwhile the operator has been at work over a large board on which a map of the city is painted, and which has holes in it with numbered plugs representing locations and numbers of fire engines and trucks. When the alarm came in, and after it was given to the engine houses and was sounded on the city bells, the operator removed from the holes in the board certain plugs, showing that the engines they represented were absent on duty. Under the guidance of a marshal at the office, or in his absence acting on his own judgment, the operator, by a series of signals over the engine house circuits, has been directing adjacent engines to take the places of those whose houses are vacated, thus providing protection for a district that otherwise would be unprotected. The second alarm comes in and away go the engines that were moved to the houses just left vacant. Again the unprotected district must be provided for, and engines in outlying districts moved in. It may be that a third alarm comes in from the same box showing an extensive conflagration, or that another alarm comes from a neighboring district. Again engines must be moved from one house to another, and the available force distributed to the best advantage over a district otherwise left without fire protection. This part of the work demands great skill and judgment. The operator plays a great game of checkers or chess on the board with his plugs, but on his skill may depend the protection or possibly the destruction of valuable property of vast extent.

Day and night, without ceasing, the same incessant watch, the same close attention, the same care and skill are brought to bear. No chances are taken. If the wheels of an engine need oiling, the engine goes out of service while the work is being done. The operator is informed of the fact, and he signals the adjacent engine to take the runs that otherwise would belong to the first engine.

These are but a part of the duties of the operator. Line repairers are continually at work

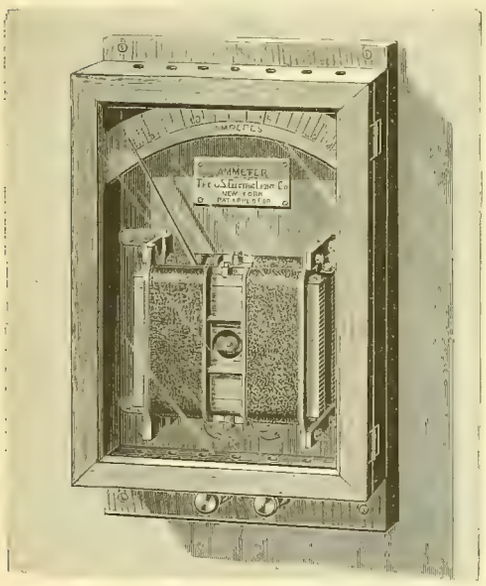


Fig. 3.—Cook County Hospital.

inspecting boxes and wires and keeping the system in the perfect order that enables the results noted to be produced. The repairer signals the electrician's department from any box through the medium of a key, of his intention of pulling that box. The operator responds, and the box is pulled. In all respects the routine, so far as the pulling of the box is concerned, is the same as that in case of a fire, but it goes no further than the electrician's office. If the box works satisfactorily it is pronounced all right, and the repairer goes to another box. If crosses or breaks occur, the location of the trouble is determined as closely as possible by the rheostat, and the line put in proper shape as soon as possible.

Last year the average number of alarms per day was five. This year so far the average has been about seven per day. Last month for forty-seven consecutive hours there was not an alarm, but the total number for the month was 221, which is an average of a trifle over seven per day.

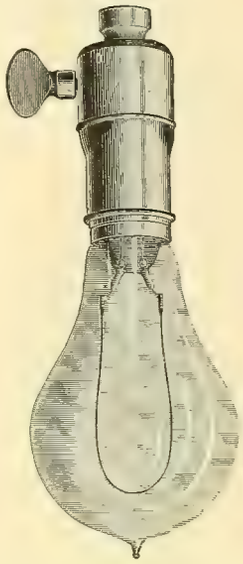


Fig. 2.—Cook County Hospital.

Unworked Territory.[1]

By C. C. Haskins.

The electric light man is to-day prodding and searching diligently and earnestly for green fields and pastures new, where he may cultivate the soil for pecuniary profit. This is proper, just and honorable, and, provided a fair, generous competition is not made to give place to ruinous opposition, there should be reasonable compensation for his efforts.

The question constantly recurs to him, Where can I go to find another opportunity? Who will come next into the fold and be made happy by an illumination which is to gas and kerosene what tea is to the cup that inebriates?

There is, as it appears to me, a field lying close about us, where a good sharp honest and earnest laborer might earn a bright dollar or two in the good cause, and as short papers are the order of the day, I purpose calling brief attention to some facts in this direction.

The average busy citizen of a metropolitan town, in these days of rush and worry, endeavors out of the mass of floating material which flows daily through the channel of the public press, to secure from the drift that which to him seems valuable, either as a mental meal or a material help to increase his monetary hoardings, and permits the rest to pass on into the eddy of another's mind. An accident involving loss of human life, is a temporary surprise—a nine-day's wonder—and is then forgotten forever, unless the reader chances to have a friend or dear one included in the catastrophe, or a loss of property makes an indelible scratch on the tablet of his memory. Within less than thirty days one of that sort of unfortunate happenings occurred almost at our very doors, by which over a score of human lives were sacrificed, and yet there are probably those within the sound of my voice who will hardly remember the fact to-day. Within the present year there have been half a dozen such accidents, mishaps, call them by the mildest names to be found in a quarto dictionary—perhaps murders—where many have been swept into eternity, with but a moment's warning, through the agency of the same dread element. In this particular instance the steamer Champlain was set on fire and burned to the water's edge, sacrificing twenty-two human beings through carelessness in securing a lamp to the hanging frame in a passage-way from the engine room to the forward freight compartment. The lamp bottom fell, the oil was spread over the floor, and in hardly more time than it can be told, that score of human beings became a band of angels. There was no need of such a sacrifice. As it is true that a theatre, an amusement hall or a public auditorium is in more danger lighted by gas or an explosive inflammable oil, which, in the former case, when a conflagration is imminent, must be shut off, and darkness result, or an explosion be accepted—a case of out of the frying-pan into the fire—or in the latter case still more and worse of the same fatal remedy, so is it true that where it becomes a case of only a few inches of pitch pine partition between time and eternity, one would certainly much prefer the light produced by a gaily singing dynamo in proper hands, to the smoke and smell and danger from the greasy, unhealthy luminous contributions of the oil room. That little 3 x 10 oil room is an excellent foundation for an argument in favor of electric lighting on shipboard. It is the *ne plus ultra* of danger, worse than the average toy pistol on the day we celebrate, or the deadliest firework of the crafty Chinaman. Every portion of one of these floating houses becomes a floating fiery furnace when ignited—and is in its normal condition a tinder-box. Everything on board, save the metal work and the pickled meat barrel, perhaps, is as ready to blaze up as a Knight of Labor when asked to hold his shovel ten hours for a day's work.

Seriously few of us, when comfortably stowed away for the night in a vessel's berth, for a moment think of the possibilities which surround us when at any instant the only choice may be between death and cremation through the fiery wall pursuing us, or the dashing, foaming billows below. The oil room, the machine shop, the kitchen, and numberless other places on board these organic fire-traps, only ask the aid of one little insignificant match to give to the world a first-class horror.

So much then for the danger. The remedy is in the hands of the electric light men. Let them attack the question right, left and center. Stir up the insurance people, hit a man in the pocket—strike the insurer in his treasury. It is within the province of the electric light fraternity to make a telling score from this standpoint.

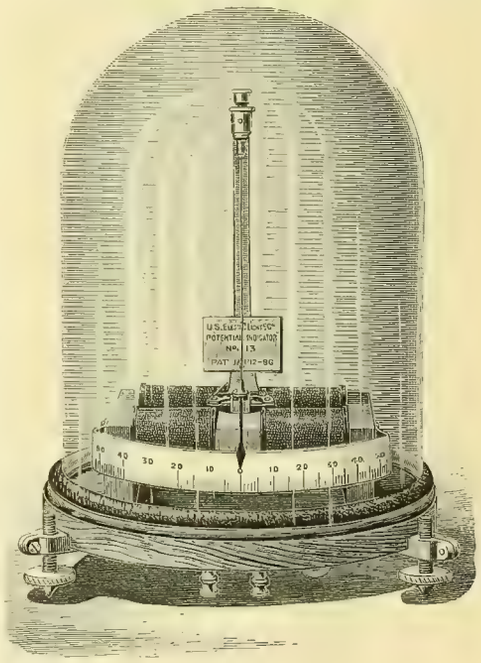


Fig. 4.—Cook County Hospital.

There is more besides the mere illumination of the vessel when away from shore. It has been proven conclusively that the electric light is the bane of the worst elements of society. The losses by theft, where freights are being loaded and discharged are heavy, and heretofore darkness, especially during rainy and snowy weather, has aided the nefarious designs of the criminals. A bunch of half a dozen or so incandescent lamps, or an arc lamp or two, on flexible cables, may be placed on the dock, run from the vessel's dynamo. The saving in theft prevention would go far towards paying the expense of the plant.

[1] Read before the Chicago Electric Club, July 11th.

There is ample room for both the arc and the incandescent systems in this line of prospecting, and there is no doubt the insurance people can be induced to favor electric lighting of marine risks. Certainly, humanity demands it; and the electric light people of the country should raise such a cyclone of noise in the ears of the owners and insurers of the marine hotels, as they would not dare to ignore.

The Silver Voltameter and Its Use.

By Prof. H. S. Carhart.

Electrolysis is the only fundamental method of measuring current strength and the E. M. F. of standards, which is applicable in ordinary electrical measurements. The electrical decomposition of water or sulphuric acid does not constitute a convenient and accurate method; and of the metals which can be deposited by electricity, silver is altogether the best one to employ, because it does not very readily oxidize, and because its electro-chemical equivalent is higher than that of any other metal, except mercury in the mercurous salts. The weight of silver in grammes, therefore, deposited in any given time, is larger than the same current will deposit of any other metal which can be employed practically. Thanks to Lord Rayleigh, Dr. T. Gray and others, the electro-chemical equivalent of silver, and the conditions necessary to its deposition, have been accurately determined; so that practical electricians have now in their hands a most convenient and reliable method of fundamental electrical measurements.

Only two typical forms of silver voltameter have been proposed. Lord Rayleigh prefers a silver plate as the anode, supported in a solution of silver nitrate contained in a platinum bowl. The silver plate in this case must be covered with filter paper to prevent the dropping off of silver oxide, which would be weighed with the silver deposited on the platinum bowl. This form is very convenient for many purposes, particularly because it is easy to wash the deposit in the bowl, and it can be handled without danger of loss in weighing. But a large platinum bowl is expensive; and, moreover, as the entire plate must be immersed, the resistance of the decomposing cell can not be changed by greater or less depth of immersion.

In the other form, recommended by Dr. Gray, three plates of silver are suspended vertically in the liquid, the middle one being the kathode. Such an arrangement is cheaper than the other form; besides, it may be used for a wider range of currents by varying the depth of immersion.

To extend still further the application of the silver voltameter, especially to measurement of

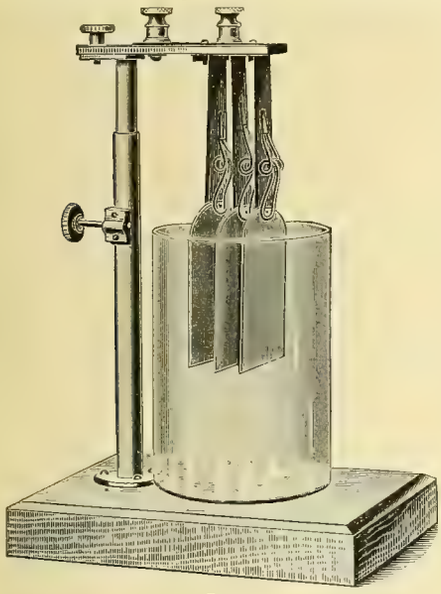


Fig. 1

E. M. F., I have made the form represented in Fig. 1. The essential point is the suspension of the plates in such a manner that they may be raised or lowered by means of a rack and pinion, as shown. The silver plates are attached to a brass strip by means of spring clips, so that they can be easily removed. The outer ones, which compose the anode, are heavier than the other, and are hung on a pin for support, the clips keeping them in position. The brass plates are screwed fast to a hard rubber cross-piece carrying the two binding posts. In the end of this cross-piece is a slot, and by a single turn of the screw at the top of the brass column, the cross-piece is released, and the plates may be lifted out of the silver nitrate solution. This is for convenience in removing the plates for washing and weighing. The two outer plates are about 6½ x 9 centimeters and 1.3 millimeters thick; the other one is only half a millimeter thick, and weighs a little less than 30 grammes. The silver nitrate is a 5 per cent. solution. This particular voltameter is serviceable for measuring currents up to half

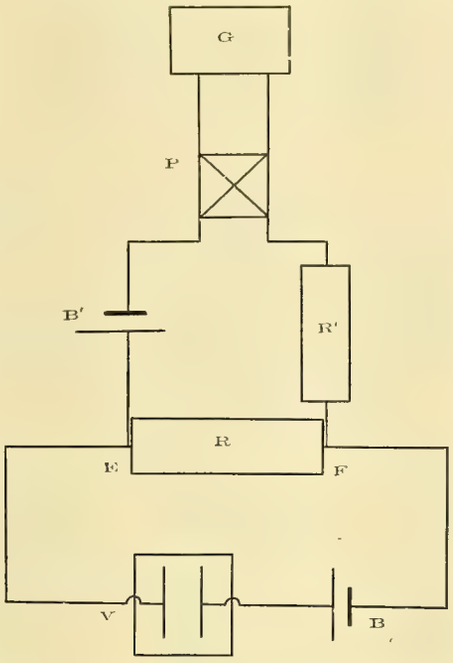


Fig 2.

an ampère. It may even answer for a current approaching an ampère if a 10 per cent. solution is used. For larger currents the plates must be correspondingly increased in size, or two or more instruments must be placed in multiple arc.

To use this voltameter for the absolute calibration of a galvanometer or ammeter, it is only necessary to connect a suitable battery, the galvanometer and the voltameter in series, and to determine the weight in grammes of silver deposited in about half an hour. With strong currents the time may be less. It is sufficient to deposit enough silver to weigh readily. The kathode plate must be cleaned, dried, and weighed to one-tenth of a milligram before the deposit is made. After the deposition of silver, the plate must be very carefully washed, first with distilled water, and then more fully with ordinary clean water, and finally soaked in distilled water. After drying, by draining on blotting paper and heating one corner in an alcohol flame somewhat above the boiling point of water, but not above 160° C., the plate is allowed to cool, and is then again weighed. Lord Rayleigh has determined the electro-chemical equivalent of silver and finds that an ampère will deposit 4.0246 grammes per hour, or 0.067077 grammes per minute. If, therefore, the weight in grammes deposited per hour be divided by the former number, the quotient will be the current in ampères. It may be remarked, in this connection, that, while the same method may be pursued with the copper voltameter, consisting of copper plates in a solution of copper sulphate, slightly acidulated with sulphuric acid; yet, the fact that copper is liable to change weight in copper sulphate, even when no current is passing, introduces a doubt into the result which does not exist when the silver voltameter is used.

The other and very important purpose to which the silver voltameter is adapted, is the measurement of E. M. F. of standards. There are several convenient methods of comparison of E. M. F.'s, when the value of the standard cell is once known. It is, therefore, of the greatest importance to have at hand an appliance by which the standard can at any time be tested with a very moderate amount of trouble. Such a test is easily made with the silver voltameter by the compensation method of measuring E. M. F. The connections are shown in Fig. 2. A circuit is first made, including a resistance R, the voltameter V, and a battery B of higher E. M. F., than the standard cell to be measured. From the two points E F a derived circuit is formed, containing a high resistance of some kind R', a galvanoscope G of high sensibility, a pole changer P to reverse circuit through the galvanoscope, and the standard cell B.' The current, which the main battery B tends to send through the derived circuit, must be opposed by the current which the standard cell tends to furnish; and the adjustment consists in so modifying the current in the main circuit, and the resistance between E and F, that no current flows through the derived circuit as indicated by the galvanoscope. When this is the case, the difference of potential between E and F equals the E. M. F. of the standard cell B.' If, therefore, we can measure the current flowing between E and F in ampères, and the resistance between these points in legal ohms, the product of the two will be the potential difference between E and F in volts by Ohm's law.

A preliminary trial must be made to determine the resistance to place between E and F, and the entire resistance in the main circuit, to admit of obtaining a balance with the proper immersion of the silver plates in the voltameter. The value and convenience of the rack and pinion on the voltameter will now be appreciated, since by means of it the final adjustment to secure an exact balance can be made. The plates are then removed, leaving the rack and pinion undisturbed, and the kathode plate is washed, dried, and weighed in the usual way. Then when the plates are replaced in their former position and the circuit is closed, it will be found that the balance is almost or quite perfect still; and it can be kept so by a slight change in the depth of immersion if necessary. The current is allowed to flow for about half an hour, the pole changer is reversed occasionally to make assurance of a complete balance, and no current through the galvanoscope; and finally the deposit of silver and the current are determined as before explained. It is quite surprising how easily the balance can be maintained during the half hour by a very slight movement of the rack, provided a battery of constant E. F. M., such as a Bunsen cell, is used.

Lord Rayleigh does not attempt to maintain a balance, but employs an auxiliary E. M. F. in the derived circuit to compensate for any difference between the E. M. F. of the standard and that between points E and F. The galvanometer will then swing first one way and then the other. The deflections must be noted at equal intervals of time, and a correction must be applied to the result depending upon the value of these deflections. This necessitates a rough time-integration of the auxiliary E. M. F., and involves a troublesome and somewhat uncertain correction. All this is obviated by the rack and pinion when the proper resistances are inserted. A high resistance is necessary in the derived circuit to protect the standard cell till a balance is effected. After that, this resistance may be removed in order to secure greater sensitiveness and a more perfect balance.

The only point about which uncertainty may exist is the resistance between E and F. With a single Bunsen cell in the main circuit, and a Clark standard cell, this resistance should be about 10 ohms. A standard ten-ohm coil may be used for the purpose and its temperature kept constant by immersion in a proper bath. Or a Wheatstone's Bridge may be connected with E and F and time measurements of the resistance may be made at equal intervals immediately after opening the main circuit. By plotting times and resistances as rectangular co-ordinates, it will be possible to project the curve backwards to the instant when the circuit was opened, and so to obtain the resistance corresponding with the temperature at that moment. The refinements to be applied in the measurement of the resistance will depend upon the exactness with which it is desired to measure the E. M. F. of the standard cell. But in all cases the temperature of the resistance between the points of derivation E and F must be carefully noted.

Theory of Telephone Cables.

Dr. V. Wietlisbach in Elektrotechnische Rundschau.

Part III.

The value of phase δ as a function of argument k has likewise been introduced into the figure.

As is shown, speed is also dependent on the number of vibrations. The influence of retardation (the misplacement of phases) makes itself manifest by extinguishing the boundary line between two sounds, one immediately following the other. Their partial tones become confused since the higher waves of the new tone advance quickly and come into collision with the deep and more slowly moving waves of the previous tone. Two forces now manifest themselves, which are antagonistic and which considerably reduce the influence of phase displacement for ordinary conditions.

As can be seen from the figure, the speed increases with the number of vibrations, so that the higher tones propagate themselves somewhat more rapidly than deep ones. On the other hand, the time occupied for a wave length is much less in the high tones. In the case of the cable which is under consideration, retardation would, at 10 kms. length, have reached the following figures with different numbers of vibrations:

Oscillations	100	500	1,000	2,000
Seconds	0.00068	0.00068	0.00057	0.00046

The differences between the delays which alone are to be considered, are so small that they do not at all disturb in the transmission of deep tones and disturb but slightly with high tones. Furthermore, we can neutralize their influence by speaking slowly, uniformly and with a voice at a uniform pitch.

It is of great practical interest to determine the length of cable in advance, through which articulation is possible. This length is, of course, only a relative idea, since the inflections of the voice, as well as the delicacy of the ear, play a very important part. If we substitute for the cable lengths set down above, the corresponding values of the product of capacity times resistance, then all results obtained can be comprehended in this, that for cables with

C.W.=100 (microfarad times ohm for the entire cable length) we have excellent articulation.

C.W.=300, good articulation is possible, but for

C.W.=1,000, articulation is difficult, and for

C.W.=2,500, it is impossible.

We must not fail to consider that in telephone systems cables are only used for large collections of wires, and that the addition of stations is effected by open and sometimes very long aerial lines. Cables usually form only a small part of a line, and for that reason their influence must be small. Even if articulation is possible through a 10 km. cable, when stations are directly attached to the cable, nevertheless articulation would be impossible if we tried to use a cable of this length in a telephone system and to attach long aerial lines to it. We shall be obliged to accept C.W.=300.

In the way of limitation, the instruments introduced into a circuit affect it much more than subsidiary aerial lines. Our theory assumes that the induction constant of a line be extremely small. Now, if calling apparatuses with strong electro-magnets be introduced into it, then this condition is no longer fulfilled, and the results of the formula become unreliable. The chief effect is to muffle the tone. In this direction Mr. Abrezal, superintendent of a telephone system in Geneva, told me of a very interesting incident: In Geneva ten Felten & Guilleaume cables, each one km. long, were laid last year. The experiments which were made in talking through them by connecting them with each other, up to 10 kms. long, confirmed as true results which could have been foretold from the above theory. At the length of one km., the usual length in use, a scarcely perceptible weakening of the voice was noticed. There seemed only to be more indistinct modulation. In other respects everything remained the same, and there was only one station which did not act properly. The apparatus in the circuit was inspected without improving matters. Close inspection in the house of a subscriber revealed two alarms which had been introduced into the circuit without the knowledge of the telephone people, and the work had been done badly. After this work had been properly done, and they were cut out when using the phone, this circuit worked as well as before the cable had been laid. Although the influence of the cable alone was scarcely perceptible, and although the induction constants of the two alarms were not perceptible in open aerial circuit, nevertheless the combination of both weakened the intensity of the waves by more than half. It is not always possible to cut all electro-magnets out of the circuit while talking, especially if several intervening exchanges are necessary to make a connection, and it seems for that reason of the highest importance in telephone operation to use the best possible cables; that is, such in which the product of the capacity and resistance is as small as possible.

Indeed, very recently telephone cables have been manufactured in which these factors have been only one-half or one-third of the value stated above, and which, for that reason, can be used over a correspondingly longer distance. [In Copenhagen conversation is carried on through a cable 8 kms. long with 23 ohms resistance and 0.19 microfarads capacity per km. (Felten & Guilleaume manufacture.) The Patterson cables used in America have even as little as 15 ohms resistance and 0.14 microfarad capacity per km.] Electro-magnets which must remain in the circuit, can be neutralized by various devices, among which have been tried shunting of both spools of an electro-magnet, introduction of condensers, or of high resistances with small induction constants. By the introduction of cables, not only the condition of the circuit, but the operation of the apparatus is decidedly influenced, and this mutual relationship between circuit and apparatus has received much too little attention in matters of telephony.

(Concluded.)

Operation of Dynamos.

The appended directions for the operation of dynamos were framed by H. Ward Leonard for the instruction and guidance of engineers in charge of Edison dynamos, but as the essential parts and their purposes and uses are described so plainly and clearly, the directions will be read with interest and profit by all engineers having dynamos in charge:

The armature is the portion of the machine which revolves between the pole pieces of the field magnet. The commutator is the portion of the armature upon which the brushes rest; this commutator should be kept perfectly round and smooth. When in good condition it ought not to spark at all under any conditions of load. The brushes when raised from the commutator should stand off from the commutator about a quarter of an inch—not more than this; and when lowered upon the commutator should have an easy motion round the shafts upon which they move, so as to insure a flexible contact upon the surface of the commutator. The ends of the brushes should be filed so that the surface of contact is as great as possible between the brushes and the commutator. The bevel of the brush should be about 60 deg., and is the same as the bevel at the rear end of the brushes. The wires composing the brushes should be free from each other, and not fused together at the ends.

The cast iron collar at the end of the commutator should have center punch or chisel marks placed upon it diametrically opposite each other, each of them in line with one of the strips of mica insulation, and in setting the brushes these two opposite marks should be taken as a standard for setting the brushes by placing the points of the brushes exactly on the mica strip in line with the marks.

The brush holder is fastened to a sleeve which moves around a short collar, the collar being fast to the supporting shaft. It is of the utmost importance that the sleeve should have a free motion about the short shaft spoken of. In case it works stiffly, take the brush holder apart and ease up the contact with a little fine emery cloth. Never use any oil on this contact, as it makes an increased resistance for the current to overcome, consequently causing heating, also on account of the liability of the oil to gum, making the parts move less easily.

The lighter the tension of the brush upon the commutator, within ordinary limits, the better. It is not best to have such a strong tension of the brush on the commutator that the ends of the brush will spread.

Between the pole pieces and above the armature is a wire screen for preventing dirt from falling on the armature while revolving. This screen should be taken out at least once a week and the surface of the armature examined as it is slowly turned over, in order to see that the armature is not rubbing against the pole pieces; as, if this occurs, it will soon lead to the bursting of one of the bands holding the wires of the armature in place, with the consequent spreading of the armature until the wires rub against the pole pieces, which would destroy the armature.

A spark which sometimes appears, when the the dynamo is in operation, upon the commutator, running clear around it and looking like a ring of fire, means that there is a slight arc between two adjacent bars and across the surface of the mica insulation. Upon stopping the machine and examining the commutator there will probably be found a small pit in the mica insulation. Then it would be necessary to turn down the commutator, and after turning it, sandpaper it thoroughly until the surface of the mica presents a firm, dense and homogenous appearance. If this spark is permitted to continue, it will gradually eat down into the mica between the bars, and whenever copper dust from the brushes happens to fill this cavity in the mica there will be a resultant short circuit causing this ring of fire. Eventually this will result in so short circuiting one loop of the armature as to burn it out, causing considerable expense. A very little sperm oil applied with a piece of chamois skin or cloth on the surface of the commutator, will tend to reduce the sparking.

The surface of the commutator, when in good condition, should present a dark chocolate colored glazed appearance.

To test the smoothness and roundness of the commutator, let the central portion of the finger nail rub against the surface of the commutator while it revolves. The nail is very sensitive to any irregularities in the commutator, and when tested in this way, the commutator should feel perfectly smooth.

Royalty on a Railway Train.

When Queen Victoria travels through any portion of her dominions, no matter whether it be from Osborne to Balmoral or from Windsor to London the precautions for her safety are very elaborate. A pilot engine precedes the royal train and is always fifteen minutes in advance. The drivers and firemen, as well as the engines are especially selected. A corps of telegraph men under a superintendent accompany the train. Special telegraph signals are displayed and all travel that would conflict with, hinder, or come in contact with the royal train or anything that would cause discomfort in the slightest degree to the regal occupant of the royal train is forbidden. The accomodations of her highness are, of course, in keeping. There are two beds in the sleeping apartment which opens from the day saloon. The beds are simple, matching the green and gilt furniture and fittings, and are something like elaborate cots in shape; and generally the interior fittings of the train leave nothing to be desired. The floors are carpeted, the ceilings padded, the wide windows curtained, and the lamps deeply shaded. Electric bells communicate with the attendants or the officials, and by pressing a button at the end of a long variegated cord or bell-pull, the alarm is sounded in the guard's van. A separate electric button is fixed in each side of the sleeping apartment, by which the attendants may be summoned; another button, when pressed, will cause the train to stop as quickly as may be.

The streets of Panama are now lighted by electricity.

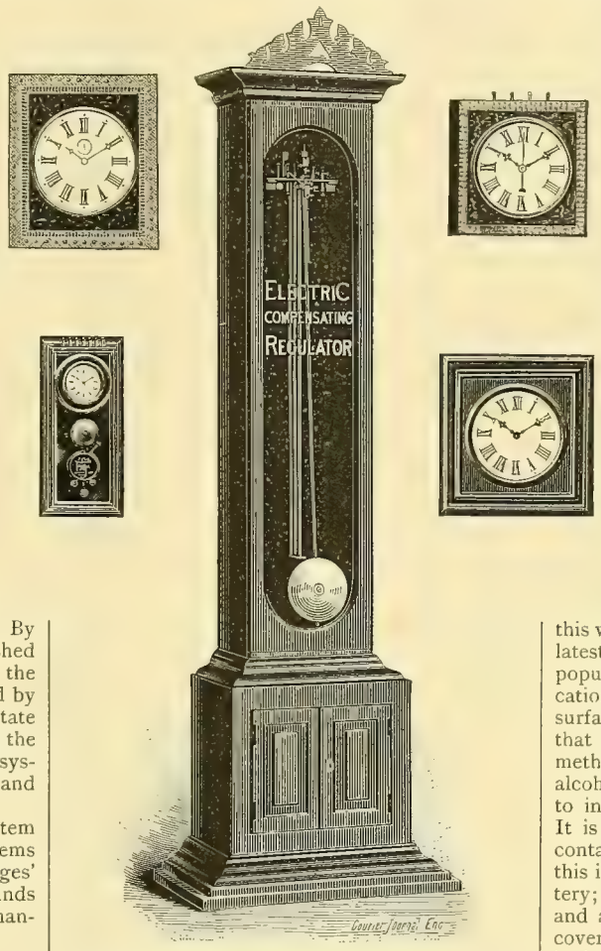
Electric Compensating Regulator.

On this page is shown a new electric time system invented by J. J. Abell and C. B. Gifford, of Colesburg, Ky. The central cut shows the principal part of the system. The idea is to make one pendulum do the work of any number of pendulums or practically to make one clock perform the work of any number of clocks. In the clock illustrations shown, the works actuating the minute and hour hands consist of but three wheels. Four styles of clocks are shown to indicate the adaptability of the system.

As will be seen the regulator consists of a pendulum with the usual weight or ball on the end. The three rods shown immediately back of the pendulum rod are designed to compensate for variation by expansion and contraction due to changes of temperature. The inventors state that the pendulum approaches very closely in practice the operation of the best pendulum in a vacuum and in proof claim that after moving the pendulum one inch from the center, thus giving it a two-inch swing, the pendulum has kept in motion from its own momentum at every trial for a period of sixteen hours. The pendulum is suspended at the top by the usual "leaf," and this in turn hangs from a supporting bar which has direct connection with the brass and iron rods in the compensation referred to. Just above the supporting bar and connected with the pendulum rod is an ingenious micrometrical adjustment which is so finely graduated that it permits of the adjustment of the rod one-two-thousandth part of an inch. The compensation and the adjustment provided for lengthening or shortening the rod are two features on which the inventors place great value.

In the base of the case a battery is placed which operates the regulator and consequently all the clocks. The system is very simple. The motive power is the current from the battery. By an arrangement of electro-magnets the pendulum is swung to one side but just as it reaches the limit of its swing, the magnets are demagnetized and the tension of a spring carries the pendulum to the limit of its swing on the opposite side of its center. By suitable mechanism as many clocks as are wished can be brought into the same circuit and the travel of the hour and minute hands governed by the swing of the pendulum. The inventors state that in a trial of eighteen months duration the regulator varied only twelve seconds. The system has been tried on a circuit of 370 miles and worked very satisfactorily.

At the Louisville exposition in 1886 the system was entered in competition with other systems and was awarded the premium on the judges' report that the honor be given it on the grounds of accuracy, simplicity and economy in manufacture.



Execution by Electricity.

Death caused by a powerful electric current is substantially the same thing as death by lightning stroke. It is instantaneous and painless, for no opportunity is afforded for any sensation to be recognized. In order that the brain may take cognizance of an impression transmitted to it by the nerves, a measurable period of time is required. This Professor Helmholtz estimates at one-tenth of a second, so that if, for example, the finger be pricked with a pin, this interval is required for the sensation to be telegraphed, so to speak, to the brain. If, then, death can be caused in less than one-tenth of a second, it follows, necessarily, that no matter how great the pain otherwise might be, it is impossible for it to be felt. As to the deterrent influence of this class of execution upon the lawless classes, it is believed that no other mode of inflicting death could inspire stronger fear. Even those accustomed to deal with electricity every day of their lives can not divest themselves of an undefined impression of mystery, which seems to surround the form of energy, of the very nature of which all men are ignorant. The lack of popular knowledge of even the most elementary laws is remarkable, and this deficiency is by no means confined to the illiterate masses. People still attribute to electricity almost every out-of-the-way natural phenomenon which they can not understand as much as they did one hundred years ago. Electro-biology, odic force, psychic force, mesmerism, and all the other shadowy theories based on odd psychical or physical manifestations or coincidences are ascribed to electricity as freely to-day as they were before Franklin, Lavoisier, Bailly, Guillotin, and the remainder of that famous committee, administered their crushing blow to Mesmer's electrical pretensions. No death is more dreaded than that which is mysterious. "Died by a visitation of Providence," we say, when the mystery can not be fathomed. The swift obliteration of life following certain failures of vital organs causes the utmost apprehension. We add to the litany a prayer for deliverance from "sudden" death. From the very earliest age, superstitions of almost every conceivable form and character have clustered about the lightning stroke, and many of them still survive. It is not difficult to conceive that the instant extinction of life in a strong man by an agency which it is impossible to see, which is unknown, may create in the ignorant mind feelings of the deepest awe and horror, and prove the most formidable of all means for preventing crime.—*Park Benjamin in the Forum.*

Transmitting Sound in Water.

The wizard Edison is now reported to have hit upon a new method of transmitting sounds from one vessel to another under water, which he has experimented upon with success in the river Caloosahatchie. The description of the process is comparatively simple. A sounder is attached to the water line of a steamer and connected with the cabin by a wire running through a tube. The steamer is also provided with a key-board of whistles. When one captain wishes to communicate with another he will turn on the steam, manipulate the keys, and send out the sounds to the waves that break against the sounder of his neighbor. The sound passes unbroken from wave to wave till it reaches the sounder, whence it will run over the electrical wire to the cabin and summon the captain by an electrical bell. He will take off the message by means of his key-board, and can then swing his vessel round and send it in like manner to another vessel seven miles away, and so on across the ocean, provided the waves are favorable and there are no chop seas to mix that message up. Is this the beginning of submarine telegraphy without cables? If there were any limit to marvels now-a-days the statement might be doubted, but it is not safe to deny anything that Edison affirms. It will be remembered that in his article in the *North American Review* describing his method of telegraphing moving trains he intimated that he was on the eve of discovering a new method of signaling at sea. Apparently he has found it, and may soon make ocean cables as old-fashioned as spinning-wheels and stage coaches.—*Chicago Tribune.*

Electro-Plating the Dead.

Wherever the population is dense—as it is in all great cities—it is seen at once that the custom of burying the bodies of deceased persons is a certain and fruitful source of disease. Water and air are alike polluted and rendered dangerous to life by the placing in the earth of the lifeless lumps of clay which will in time be resolved into their original elements, but which, in the meantime, give forth noxious exhalations. For this reason the practice of intramural burial has been done away with and modern cemeteries are placed as far as possible from municipal centers. In lieu of inhumation, the scientists of the present day have devised four methods—namely, cremation, cementation, coking, and electro-plating. Cremation is only the classic funeral pyre, without any of its unpleasant and revolting attendants. The body is reduced to a handful of ashes by intense heat in a furnace so arranged that nothing disagreeable passes off during the process. The process of coking is similar; but instead of being burned, the body is exposed to a flameless heat and reduced to a hard, brittle substance instead of to ashes. Cementation does not deal directly with the body, but with its environment. It consists in hermetically sealing the coffin by placing a coat of the finest cement all around it. The advantages of a sarcophagus are in this way secured without much expense. But the latest method, and one which is growing into popular favor, is electro-plating. It is the application of a perfectly even metallic coating to the surface of the body itself by the same process as that which produces an electrotype plate. The method is briefly this: The body is washed with alcohol and sprinkled with fine graphite powder, to insure the perfect conduction of electricity. It is then placed in a bath of metallic solution containing a piece of the metal to be used; to this is attached the positive pole of a strong battery; the negative pole is applied to the corpse, and a fine film of the metal at once begins to cover the body perfectly and evenly. This may be kept up until the coating attains any desired thickness. To this process there would seem to be no valid objection. In effect it transforms the corpse into a beautiful statue—form, features, and even expression, being perfectly preserved. The body being hermetically sealed within its metal inclosure, merely dries up and assumes the aspect of a mummy. This method obviates many objections which have been urged against cremation, and at the same time meets the wishes of those whose sentiment, if nothing else, inclines them to favor the ordinary way of burial. The feeling of the desecration of the human form divine, which its reduction to a handful of ashes causes to many people, is entirely done away with, as no rude hand is laid upon the once-loved form. No change is brought about in appearance except that face and figure are covered with a shining veil, through which the familiar lineaments appear with all their well-remembered characteristics and expression.

It Quickens the Hearing.

"At any lecture," says a telephone girl, "where the speaker can be heard only with difficulty, it will be seen that every listener will turn the ear he uses at the telephone. This would seem to prove that the telephone quickens rather than dulls the hearing."

Western Electrician.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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The Carbon Combination.

Special Dispatch to the WESTERN ELECTRICIAN.

CLEVELAND, O. July 13.—It is rumored here that Boulton has withdrawn from the United Carbon companies, and that the combination is practically broken. It was positively stated to your correspondent that Boulton has sold in the neighborhood of 600,000 carbons within two or three days, and since his withdrawal, at prices about the same as those which existed before the combination was consummated. It is said that these carbons were sold by telegraph for cash through C. L. Wright and F. E. Pettingell, of the Cleveland Electric Motor Co. It is claimed here that Boulton never favored the combination; that he protested against the price being put up so high by the United Carbon companies, and that he took the first opportunity to withdraw. It is thought here that with Boulton out and competing, the combination will not be able to stand the situation of affairs. This seems likely to bring about the prediction made in your editorial last week, namely, that it will not be possible to hold up the price of carbons to the figures asked by the combination.

The directors of the Bell Telephone company were to meet the 13th, and it was expected that they would declare an extra dividend of three or four per cent. The dispatches conveying this information also stated that President W. H. Forbes would send in his resignation, and that Howard Stockton would succeed Mr. Forbes.

WE conclude in this number Dr. Wietlisbach's interesting paper on the "Theory of Telephone Cables." In the next number we shall publish the first part of a series of comments prepared by W. R. Patterson, the inventor of the Patterson cable and an expert of high standing. His paper will command attention.

IN an interview between Professor Gray and an editor of this journal, when his improvement of the telautograph was first announced three weeks ago, and previous to the appearance of any unfavorable comment, the professor distinctly admitted the original invention of the instrument by other parties, and referring to an English invention of the kind, said that in the English instrument the paper was in constant motion and the writer had to keep the pen continually in contact with it, whereas in his invention the writer stopped at the end of each line, and by touching a button moved his paper up the proper distance for the next line. The chief merit in Professor Gray's invention seems to consist in reducing an impractical invention to a practical one, and if he succeeds in this he will merit public approbation as truly as the original inventor. This is eminently a practical age, and ours is eminently a practical country, and it is the practical man who wins the prize.

THE disposal of the dead is a question that has received much consideration, particularly of late years, and in large cities, and it is a question that will demand more and more attention as years roll by and established burial places become filled and new locations have to be sought.

Sanitary science, on the one hand attacks the method so universally practiced of placing bodies in the grave, and says they molder and decay and become the source of disease and may be death, through the poison that emanates from them, and makes its way, either through the soil to the sources of the water that furnish drink for the living, or upward into the air, producing the fatal germs of disease. Science suggests cremation, either on the pyre or by the process of ooking, or cementation, which consists of hermetically sealing the casket containing the remains.

Sentiment, on the other hand, abhors two, at least, of these methods—those in which the remains of the loved ones are consumed by fire and reduced to ashes. Sentiment remembers the dead as the dead of the past and not the dead of the present. To the process of cementation there can not be much objection. It is largely followed in many places. Science now suggests still another method, which seems to have even less objections than any of the others. It is that of electro-plating the dead. "In effect"—to quote the words of the article printed in another place—this process "transforms the corpse into a beautiful statue—form, feature, and even expression being perfectly preserved. No change is brought about in appearance except that face and figure are covered with a shining veil, through which the familiar lineaments appear with all their well-remembered characteristics and expression."

PROF. CARHART's article in another column on the silver voltameter and his improvement of it will be found interesting and instructive. Nothing is more necessary in electric science than exact measurement, and any improvement in existing instruments, as well as the invention of new instruments, is a step in the right direction. The measurement of electric energy in any form is very much like that of the boy's attempt to count the pigs; one little pig ran round so that he could not count him. So in the different manifestations of energy, heat, gravity and electricity; we can measure the heat and the gravity with comparative ease, but electricity is the one little pig always on the run, which we can not hold long enough to count.

The process of Professor Elihu Thomson of welding metals by electricity promises to work a revolution in the industrial arts. By this process the pieces of a knitting needle or of the steel shaft of a steamship can be so perfectly united that the union can not be detected. The professor has experimented on iron and steel and other metals and in each case the results have proven the wonderful adaptability of the process. We hope to be able to present later an article from the inventor giving the details of the process.

The Evolution of Inventions.

It is interesting to study the gradual evolution of an invention by the process of exclusion, by finding out what would not do; and, second, the apparent chain of connection, running, perhaps, for over a century, through several generations of inventors, each evidently profiting by the failures of his predecessors to the extent, at least, of avoiding their repetition. Is it not evident that the earlier inventors would have accomplished greater results had they had a larger range of scientific experiments and advice; and that Watt triumphed because he had the whole faculty of the University of Glasgow at his back to give him knowledge of natural principles and information as to what had been done? So with numerous other inventions named—especially the steamboat, the locomotive, the telegraph, the sewing machine, the reaping machine, etc., each of which was referred to at greater or less length. It is a mistake that ordinary technical societies usually discourage speculative papers and discussions, and prefer to hear of accomplished facts; but the busy men who are developing this country need something more—they need to keep up with discovery before it is reduced to practical account, and they need that personal contact and sympathy with men of science which nothing can replace. Engineers, as well as other practical men, owe it to themselves to come to such meetings, bringing accounts of what they have done and hope to do, and especially what they have failed to do, and why; and some speculative papers may well be allowed, providing always that they are on sound basis and stick to facts; for how often is it that the imagined things of to-day become the accomplished results of to-morrow.—*Driftwood.*

Yes, the dreaming scientist is as important a factor in the result as the practical inventor; the one elaborates principles, the other applies them. It is the old story of mutual dependence, "The eye can not say unto the hand I have no need of thee, nor again the head to the feet I have no need of you."

The American idea, and, especially the western idea, is to arrive at practical results by the speediest methods; and in doing this we are liable to become superficial, and to overlook the importance of purely scientific work. The one is necessary for the development of the other; the thinker in the departments of pure mathematics and physical science renders possible the results which the practical mechanic achieves; the scientist's laboratory and the mechanic's work-shop mark the different stages through which every great invention must pass.

Tempering Steel with Electricity.

At the shop of the Sedgwick Mainspring Co., 19 and 21 South Canal street, Chicago, can be seen a very interesting application of electricity to the arts. It consists of tempering watch springs by means of the electric current. In one part of the room stands what is known to the trade as a one-light dynamo. The conductors from the dynamo lead to another part of the room to a bench on which stands an ordinary oil tempering bath. One of the conductors connects with a point within the oil bath and the other to a point without. The piece of flat soft steel wire that is to be tempered to the blue color is fed under the contact point on the outside of the bath first and then under the one on the inside. When it reaches the latter the circuit is complete and the wire immediately and uniformly becomes heated. No means have been taken to measure the current exactly for the purpose of doing the whole work mechanically. The variation in the percentage of carbon in different pieces of steel forbids the delicate process of tempering from becoming a purely mechanical piece of work. Therefore, with the electric current as with a fire, the color of the steel determines the length of time that it shall be heated. Several advantages are claimed for this process of tempering. The chief one is that the steel does not have time to oxidize after it has been heated to the proper color before it is under cover of the oil and consequently that the steel wire is of the same thickness when it is tempered as it was before it entered the process. The heating is uniform throughout the length of the spring and there is less liability of defective spots. The process is a rapid one, the springs being heated and passing into the bath at the rate of four inches a second.

The large watch making concerns look with great favor on the new process and the Sedgwick Mainspring Co., are just about to double their capacity for the purpose of keeping up with their orders.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number III.

The Dynamo—Its Mode of Action.—Since the lines of force which pass through the magnetic field are taken up by the armature and circulate through its coils, as already explained, it is evident that to do this they must traverse the armature core; and as the resistance of the core is almost zero as compared with that of air, its presence in the field greatly facilitates this magnetic transmission, the lines of force always following the path of least resistance. If the armature had no core, or if its core were one of high resistance, it is evident that a large percentage of those lines would pass through the field without being intercepted by the coils, and their effect in generating the electric current be lost; but the core itself intercepts them and leads them through the coils, so that the number which escape interception are comparatively few. It would be quite possible to construct a dynamo without an armature core, or with one of high resistance, but its energy would be comparatively low, depending solely on the electricity induced by the field magnets. The great advantage of the iron core consists not only in leading the magnetism through the coils without loss, but chiefly because it makes the armature itself an electro-magnet, acting reciprocally with the field magnets to multiply the magnetic and electric effects by mutual reaction.

If there were no iron core in the armature the lines of force would run nearly parallel from one pole to the other, the concavity of the pole pieces producing parallelism in lines which would be divergent if radiated from one plane surface to another. The same parallelism is found to exist when the armature is not rotating, as shown in Fig. 8, where the lines passing into the armature in the central region are seen to be parallel, while those at the extremities of the pole pieces, above and below, are slightly curved. It will be noticed that the lines are denser near the extremities than in the central region; and that the relative number passing through the interior of the armature, not intercepted by the coils, is comparatively few, as already stated.

When the armature is rotating in the direction of the arrow as shown in Fig. 9, it is found, that, in consequence of the rotation and the resulting reactions, the points of greatest magnetic intensity are at the lower right, and upper left hand

Fig. 8.

corners. It is also found, that from various causes which can not here be enumerated, the magnetic poles of the rotating armature are not in line with those of the field magnets, but are near the points of greatest magnetic intensity, as shown; each pole of the armature facing the opposite pole of a field magnet, as indicated by the lettering, so that the direction of magnetic movement from north pole to south pole remains unchanged though the lines of force are greatly contorted, entering at the lower right hand corner, traversing the coils on opposite sides of the armature, and emerging at the upper left hand corner; the position of the poles remaining stationary while the armature itself revolves, so that they traverse every part of its circumference during each revolution.

The electric movement being at right angles to the magnetic, the points of the greatest electric intensity in the armature are at the ends of a diameter placed at right angles to the diameter joining the points of greatest magnetic intensity; and at those points the brushes are placed as shown in Fig. 9; the current entering the armature from the main circuit at the lower brush, and emerging at the upper brush.

When a new dynamo is completed and ready for use, it is found that the iron, during the various manipulations to which it has been subjected, has become slightly magnetic, and this residual magnetism, as it is termed, is the germ of magnetic and electric energy from which the full power of the machine is derived.

When the armature begins to revolve, and its coils intercept the lines of force from this residual magnetism, found in the field, incipient electric currents are generated in them, which, having been commuted into a single constant current and taken up by the brushes, circulate through the coils of the field magnets. This incipient current induces magnetism in the cores and thus increases the magnetic intensity of the

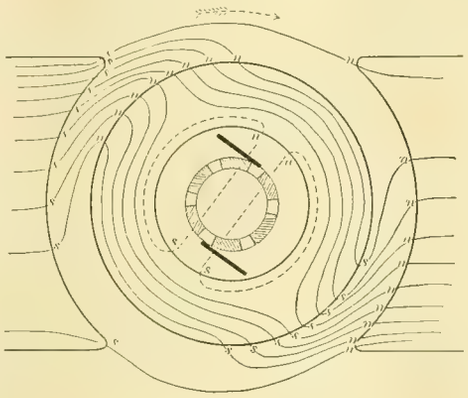


Fig. 9.

field, so that the armature coils intercept an increased number of lines of force. This increases the magnetism of the armature core, inducing greater energy in the electric currents generated; and these currents passing into the field magnet coils as before, continue to increase the magnetic intensity of the field. Thus magnetism augments electricity and electricity reacts to augment magnetism, and this series of reciprocal reactions between the armature and the field magnets, and between the magnetism induced in the cores of each and the electricity induced in their coils, increases the magnetic and electric intensity of each in geometrical ratio, so that in a few moments the incipient current, induced by the feeble germ of residual magnetism, has become the powerful current which produces from a series of arc lamps a light of 100,000 candle power.

When a dynamo stops running its electric and magnetic energy cease, but it still retains the residual, so that when put in operation again its energy is rapidly developed, and the electric current generated as in the first instance.

It is evident from the manner of electric development as described above, that the electric energy generated must vary as the speed of rotation of the armature, so that the more rapid the rotation the greater the energy developed. But there are certain limits which can not be exceeded, dependent chiefly on the strength of material and the incidental development of heat. If the limit of strength is exceeded the armature is liable to fly in pieces, and if too much heat is developed the insulating material may be charred and permanently injured, or the electric and magnetic properties of the metals be temporarily reduced. The development of a certain amount of heat is inevitable, and it varies in different dynamos according to the method of construction. Hence the adjustment of speed in each case becomes an important item. Taking the number of feet in the circumference as a basis, the rate of speed in most dynamos varies from two to three thousand feet per minute, while in some it equals 5,000; that is, that number of feet of circumference passes a given point in a minute; and the number of revolutions per minute, in any case, can be ascertained by dividing by the number of feet in the given circumference.

To the ordinary observer, not versed in electric science, and especially to the mechanic, accustomed to visible, tangible resistance requiring power to overcome it, the resistance of the dynamo is a profound mystery. Here is an armature capable of being put in rotation by a few pounds pressure applied with the hand, and rotating apparently in empty space; but through some invisible agency the resistance increases with the speed, till, in a few moments, an engine of a hundred horse power is required to sustain the rotation. But this apparently empty space is the magnetic field through which radiate an infinite number of lines of force, cut by the armature coils, and generating the electric current in the manner described; so that the resistance, though invisible, is as real as that of the machinery of a factory. It is, in this respect, a resistance similar to that of gravity, unseen, intangible, yet real.

The Northern Lights.

When, in 1792, Franklin succeeded, through a kite sent up into a storm-cloud, in obtaining an electric spark at the extremity of the cord, which had been made a conductor by the rain, it was no longer possible to doubt that lightning was but an immense electric discharge between two clouds, or a discharge between a cloud and the earth. This discovery was of great importance, since it connected with the laws of physics certain phenomena which, until then, had passed for marvelous, and in which nothing but supernatural and mysterious manifestations were seen.

The aurora borealis, which is more difficult to understand, and which necessitates more extended scientific notions, has remained much longer unexplained. This enigmatic phenomenon was especially striking to the imagination of ancient peoples. It was regarded as an omen of inauspicious events, and the historians who describe it affirm that, at times, armies have been seen passing through the bloody heavens, and that the clash of arms has been heard.

It is now known that the aurora borealis has the same origin as lightning, that it is one of the visible manifestations of atmospheric electricity, and that it is due to slow movements of that fluid, while lightning is the result of violent motions. The effects of the aurora and of the thunder bolt are absolutely different; but between them there is an intermediary that connects them, and this is heat lightning.

These elementary notions are now the property of science; but the study of the aurora has hitherto been only partially outlined. Travelers and physicists have, indeed, given numerous descriptions, but it has remained to find the bonds that unite these so important phenomena in the economy of the globe, to study the causes that set them in action, to observe the correlations that they may offer, and to discuss theories. This is a labor that Mr. S. Lemstrom, the great Finnish physicist, has been engaged in for several years.

The author of this important work, who has long been occupied in the study of the aurora borealis, so frequent in his country, was attached to the polar expedition made in 1868 by Nordenskjold. He was led to begin a series of important observations. In 1871 he visited Finnish Lapland, and, after a series of ingenious researches, constructed an apparatus that permitted him to artificially reproduce the light of the aurora, and to present science with a summary of new and incontestable facts.—*Mining and Scientific Press.*

The above item relates to a very interesting subject, and the ideas are in the main correct; but the writer is slightly at fault in regard to electric "fluid" and "heat lightning." The idea of electricity being a fluid is a hypothesis of the past no longer entertained; and the so-called heat lightning is, in all probability, nothing more than the flash from thunder-clouds, either below the horizon or so near it as to be invisible in the darkness, and through the dense lower atmospheric strata, and so distant as to render the accompanying thunder inaudible.

The Sydney, Australia, lighthouse is the largest lighthouse in the world. It has a power of 180,000 candles, and can be seen 50 miles. The largest light in America is 24,000 candle power. It is at San Jose, Cal.

Chicago Electric Club.

The Chicago Electric club met Monday evening, July 11th, for the first time in their permanent quarters, on the ground floor of the new building at 225 Dearborn street. C. A. Brown, first vice-president, took the chair, in the absence of the president, Gen. A. K. Stiles.

Among those present from out of town were C. O. Mailloux, of New York, and Col. Geo. L. Beetle, who is at present making his headquarters at Kansas City.

The business of the meeting, which was of a routine character, was quickly disposed of, and C. C. Haskins was called upon for the first contribution to the club's literature. He read a paper on "Unworked Territory," which is given in full in another place in this issue.

Mr. Mailloux, upon being called upon for some remarks, complimented the club on its progress and its quarters, and then commented upon the main thought of Mr. Haskins' paper. He thought the field in marine lighting was a wide one, but said, of course, in lighting vessels by electricity there was the element of weight to contend with, that is, if the plant was to be of sufficient capacity to maintain the lights when they were all in use, the element of weight would be a factor of considerable importance. He suggested a way to avoid this difficulty by the use of storage batteries, charging the batteries during the day time when no lights, or only a few, were in use in dark places in the hold, and using dynamos and storage batteries at night in conjunction.

An interesting discussion originated with H. Ward Leonard, in a request for the experiences of others in cases where persons were severely shocked by electric light currents, and what means were taken for resuscitation.

Mr. Stewart related an instance where a man who had received a shock was revived by continuous rubbing for about two hours. An experiment had been made on a cat, and the animal was resuscitated after about four hours' rubbing. In response to a question, Mr. Stewart said the man had been burned and had received a very severe shock.

Mr. Mailloux spoke of a man working with a 25 arc light machine. In some way there was a contact between a part of the circuit and the floor, and upon attempting to adjust the brushes he short-circuited the machine through his body. The assistant wrenched the brush away, although it required a well-nigh superhuman effort. One of the hands of the man was very severely burned. The shock left him paralyzed for about three months. Now he is as well as ever, though he still suffers some discomfort from the hand that was burned, but the effect of the current upon his system has entirely passed away.

F. B. Badt regretted that accidents of this nature were so meager in details. He believed that every circumstance and every detail should be carefully jotted down, and then statistics—the Queen of Sciences—would give us the means of determination of the causes and the methods of avoiding them. "It has hardly been demonstrated," said he, "what killed a man. There is always some talk about getting into a current, or getting a current through the body. It has always seemed to me that whoever got very severe shocks got them not by getting the body into the direct current, but what caused the shock was a secondary current, which was gotten by either breaking or making contact at the moment death occurred. I know of one instance where a man got his whole body into the circuit of a 20-light arc dynamo. His assistant went to the engineer and told him to stop the engine. Instead of doing so, the engineer pulled a wire out of the dynamo and the man dropped dead. That would indicate to me that the man was killed not by the current from the dynamo, which may have been in the neighborhood of 1,000 volts, but by a current of higher electro-motive force. There is another thing: If a man gets a very severe shock by getting his body in a circuit, electrolysis will take place."

E. P. Warner said he had done some experimenting to ascertain what this extra current was. He took a series field of an ordinary 25-light dynamo. This field may have been about four ohms resistance. In that circuit he included a single cell of Callaud battery. The strength of the current was about one-fourth ampere. "Upon breaking the circuit, and having hold of the wires, I got shock enough to lay me on my back. I think if I had had a current of a single ampere in those fields, I would have been killed."

Mr. Mailloux said that experiments had been made upon animals with the induction coil, and said that high electro-motive force did not kill *per se*. There must be some current passing in sufficient volume to do the damage. "It occurs to me that in view of the liability of such accidents, it would be well to provide all arc lighting machines with safety apparatus, so that the engineer will not pull a wire out. There is one way of doing it, and that is to short-circuit the field."

A. H. Brown spoke of a man who got into the direct circuit of a 45-light arc dynamo. He had two binding posts of a switch board with loose connections in his hands, and the current burned out the inside of both hands. In every case, said he, in Chicago, where accidents of this kind have occurred, the persons have been badly burned. A New York physician claims that it is paralysis that kills.

E. P. Warner thought it was the E. M. F. that killed, whether it was the secondary or primary current.

The unanimous expression of the club was that Mr. Badt prepare a paper on this subject, to be read at the next meeting of the club.

The club adjourned, subject to the call of the secretary.

Death of Jackson Bailey.

Jackson Bailey, editor and one of the founders of the *American Machinist*, died at his home in Brooklyn, N.Y., Thursday, July 7th, in the forty-first year of his age, of consumption of the bowels.

Born at Schenectady, N. Y., May 12, 1847, Mr. Bailey enlisted as a private in the One Hundred and Thirty-fourth regiment of New York infantry at the age of fifteen, and served three years to the close of the war. He was at Missionary Ridge and in several other battles, and served in Sherman's army during the march to the sea. Mustered out of the service at eighteen years of age, he entered the State Normal school at Albany, N. Y., from which he graduated in due course and afterward was engaged in teaching. Later on he connected himself with a New York publishing firm, which position he relinquished to become New York representative of the *American Manufacturer and Iron World*, of Pittsburgh.

In November, 1877, the *American Machinist* was established, Mr. Bailey retaining his connection with it up to the time of his death. He leaves a widow. At the time of his death Mr. Bailey was first vice-president of the New York Press Club, a Mason, and a member of a number of engineering societies. The funeral took place from his residence Sunday, July 10th; interment at Cypress Hills Cemetery in Brooklyn.

Gentleman, soldier and journalist, he has gone to his rest. We can but point to his proud career as an example to others and mourn that our profession has lost one of its most valued members.

Words of Greeting.

The Electrical World, July 9th: The WESTERN ELECTRICIAN has made its début in Chicago in a very creditable manner and shape. Its contents are interesting and well edited, and the paper, typography and presswork are all excellent. The venture has much promise of success, and we tender Mr. Kreidler our congratulations on what he has already achieved.

The Electrician and Electrical Engineer for July: We look with much interest for the first number of the WESTERN ELECTRICIAN, a new weekly journal announced to appear July 2d, under the management of Mr. W. A. Kreidler, of Chicago, associated with Mr. J. Wayland Clark. Mr. Kreidler has for several years attended to the western business of the *Electrical World*, and has accumulated valuable experience in electrical journalism. In everything western, one looks for energy and dash, and we make no doubt, that the WESTERN ELECTRICIAN will keep abreast of the current of western life and business, and keep an eye on what is going on in the rest of the world as well.

The Electric Age, July 1st: On July 2 the WESTERN ELECTRICIAN is expected to make its appearance in Chicago, Ill. Mr. W. A. Kriedler, who has been for several years Chicago representative of the *Electrical World* will be the editor of this new journalistic enterprise.

Professor Gray's Telautograph.

Shortly after the publication of a description of Prof. Elisha Gray's telautograph, a correspondent signing himself "Coates" appeared in one of the daily papers with an article headed "Gray's Invention a Chestnut." This drew out from J. E. McKibby the following:

The article headed "Gray's Invention a Chestnut," signed "Coates," does not reflect in the least on Gray's ability as an inventor or upon his invention, neither of which need any defense nor laudation from any living man's pen, but the caption and evident relish with which Coates divests himself of this wet blanket (?) causes a feeling of remonstrance to rise within me. In 1850, probably before Mr. Frankel was born or Coates had covered himself or any one else with glory, certainly before Gray had completed the carpenter trade, F. C. Bakewell, of London, brought out his "Copying Telegraph" for transmitting anything that could be put on paper, by means of a pen, and reproducing it at the distant end. In 1856 Abbe Casselli, of Florence, Italy, introduced his pantelegraph (autographic), which before its final abandonment attained a speed of sixty messages per hour, averaging twenty to twenty-five words each on the Paris-Lyons circuit. Then came Meyer, of Austria; Lenoir, of France; W. E. Sawyer, Washington, D. C.; Amos E. Dolbear, Smith, Edison, *et al.*, up to 1879, when E. A. Cowper, of London, acquired United States patents for his invention. In 1881 Leggo gave his invention to the world, upon which was formed the American Autographic Telegraph company, now the Postal Telegraph and Cable company. In 1886 Robinson, of New Jersey, acquired United States patents for a machine very similar to Cowper's who also acquired fresh patents in 1886. Except Robinson's, they are all housed where the public won't mistake them for O'Donovon Rossa's "missionaries." The history of the telephone is analogous. Borseul, 1858; Reiss, 1864; Yeates, Varley, 1865; Meucci, Cushman, Drawbaugh, Vanderweyde, Pickering, Cross, etc., all had "telephones," "talking telegraphs," etc., but Bell made it commercially practicable in '76 and '77, twenty-five years after Cushman, in Racine, Wis., claims to have talked yards and yards of talk over miles and miles of wire. The dates and names on the autographic telegraphs herein given are from well-known electrical text books treating of telegraphy, and are to be found in all electrical libraries and the Chicago Public library. Possibly Mr. Frankel's failure to take out patents was due to a little knowledge which Coates evidently lacks, and doubtless were he to apply to Mr. Gray the latter would loan him some of his old text books that are out of date, from which he may read up—that is, get a "few pointers."

New Telegraph Line.

In relation to the construction of the proposed lines of telegraph by the Pacific Mutual Telegraph company connecting Kansas City with Sioux City and Denver, E. L. Martin, president of the company, recently said: "Arrangements have been almost consummated for the construction of the line to Denver, and it is expected that they will be completed within a few days. In regard to the Sioux City extension, the plans are fully matured and we expect to have the line in operation by November 1st. If everything works as well as we anticipate, the Denver line will be completed a little later. The lines of the latter will be constructed along the route of the Western Union company, and we will perhaps meet with some opposition from that company, but expect nothing serious."

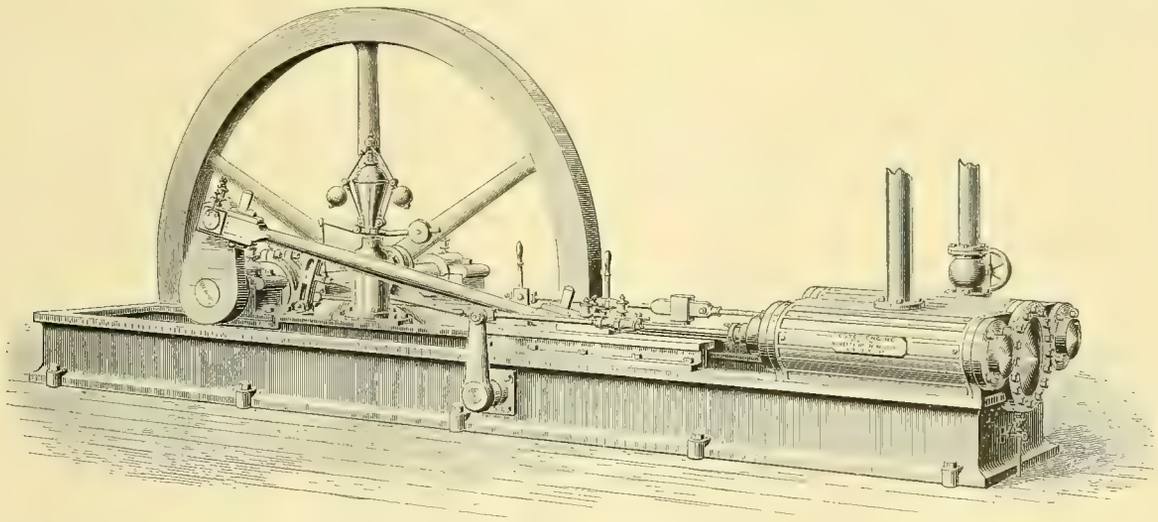
The Estes Automatic Cut-off Engine.

We present to our readers an illustration and description of the Estes engine, which has claims for novelty and is a favorite with many steam users. It is an automatic engine and the makers claim many points of excellence.

It can be run at high speed. The valves are perfectly balanced at all points of the stroke and under complete control of the governor under any variation of boiler pressure. The valves are provided with expanding rings, allowing for adjustment of any wear that may take place in the course of time, which however has proved after four years' use to be so slight as to be hardly noticeable. In addition to this, there are no dash pots to get out of order and prevent the engine from recovering on a sudden addition of work after the cut-off takes place. The engine will take steam at any point of the stroke when sudden work is thrown on, which is a great advantage over all that class of engines with drop cut-off, as in Corliss styles. The valves are so constructed that the covers can be removed and the action of the valves seen while the engine is running, and any leakage instantly detected and stopped. The exhaust valves are on opposite side from steam valves and operated entirely independent. The ports are very large and direct. The valves open and close quickly, giving high initial pressure and fine grade of expansion.

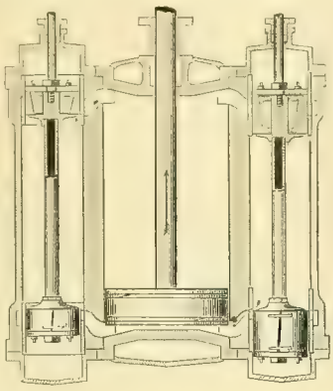
All the parts are made exceptionally strong with large bearing surfaces. The valve seats are removable, so they can be easily replaced if necessary and enable us to obtain perfection of material for same. Above is a sectional view of steam valve and chest. Steam is admitted between the two pistons and exhausted between them. Exhaust valve is opposite this and constructed in the same manner.

The valves open and close quickly, the ports are large and direct giving a high initial pressure and fine grade of expansion. The valve mechanism is simple and positive. The engine will take steam at any point of the stroke, when sudden work is thrown on, as in rolling mills or saw mills, which make it peculiarly well adapted for this class of work. All the parts are made exceptionally strong, with large bearing surfaces. The engine is simple in construction. It can be operated by any good engineer, which they always recommend, as readily as an ordinary slide valve engine.



Electric Lighting of Railway Trains.

At the recent meeting of the American Institute of Electrical Engineers in New York, George W. Blodgett, of the Boston & Albany road, read a paper on electric lighting of passenger trains. He gave a description of the apparatus in use on the Southeastern Railway of England, where a train fitted with electric lights, supplied by dynamos in the cars, has been running for some time, and reported that his experience with the trains running between Boston and New York was, thus far, satisfactory. He has the battery boxes under the cars, arranged with stout brass springs on their sides, so that the simple act of placing them in position connects them together so that no wire connections have to be made or broken, either in putting them in or taking them out. Mr. Blodgett has designed an apparatus for combining the switches connecting the batteries with the lamps inside the cars, and with the terminals used to connect the charging battery, by which the manipulation is rendered very simple and errors by careless or inexperienced attendants obviated. The cost of operating the lights is about $2 a car each day, or one cent an hour for each lamp. Of the electricity supplied to the storage batteries from the original source, from one-fourth to one-third is lost. Respecting his experience with primary batteries on trains, Mr.



Blodgett says that most batteries furnish a continuous current for so short a time without renewal that their use is debarred on this account. Some others will not bear the shaking up produced by the motion of a train. An attempt was made two or three months ago to light a New York Central passenger car with batteries of some kind, which failed. He says that he has himself experimented for a considerable time, but thus far without finding a battery which will run on a closed circuit longer than two or three weeks, and at the same time can be carried on a train. When such a one can be found, which at the same time gives a current strong enough to light a series of lamps, it will have, he thinks, a great field of usefulness.

Will Make Its Own Carbons.

The Thomson-Houston Electric company hereafter will make its own carbons.

A Storage Battery on a Street Car.

Half-a-dozen New York capitalists, as many prominent Philadelphians, and many newspaper men met, says the Philadelphia *Times*, to witness a series of tests with an ordinary street car stored with electrical energy. The experiments were successful. A line of rail 1,050 feet in length had been laid down in the yard, with a radius of thirty-three feet, steep inclines with a rise of 5 per cent., and placed in such a manner that every reasonable test could be applied to the invention to prove its practicability. The car used was one of the People's Passenger railway, which has done regular service. To this car was attached an electric motor, suspended upon one of the axles underneath the car. The storage battery consisted of eighty-four small cells placed under the seat. The capacity of each cell is 150 ampere hours, and is equivalent to two-fifths of a horse power for one hour for each box, giving a storage energy of about thirty-four horse power hours.

Thirty-three people crowded the car on its first journey, and the vehicle ran along with perfect smoothness and entirely under the control of the driver, who manipulated a small handle. The car was stopped and started with ease on the straight, at the curves, and on the steep grade. It was stopped and reversed instantly, and every test applied was answered satisfactorily by the little machine. The rate of travel averaged from one to ten miles an hour, without noise or vibration, and with smoothness. The whole propelling apparatus is out of sight, and there is no danger to persons touching any part of it. The car was completely under control of electricity, the alarm bells, the signals, and the lighting, all being automatically performed instantaneously.

The plates can be recharged by means of a dynamo machine of ten horse-power, driven by a gas engine, and they then are placed in the car on trays by one man. A force of ten horse-power for four hours is required to charge the accumulators once, and if they are replaced four times a day (which is more than is really necessary), the cost of steam power, inclusive of wages, water, oil, and repairs to engine, would amount to $1.60 a day of sixteen hours.

Messrs. Kemble and Widener have granted the use of their lines for the purpose of perfecting the invention, and before a week has passed an electro-motor car will be gliding along the streets of Philadelphia.

A New Standard Galvanic Cell.

M. Gouy, in the *Comptes Rendus*, has recently described a new form of standard galvanic cell, which is of simple construction, and can be used with either galvanometers or electrometers. The cell is composed of zinc and zinc sulphate, with mercury and mercuric oxide. The mercury, which should be previously well purified, is placed in a flask, so as to form a layer of 2cm. to 3cm. in depth. Immersed in it, and sealed into the glass, is a platinum wire, which thus forms the positive pole of the element. Yellow mercuric oxide covers the mercury in the flask, and above this layer is placed a 10 per cent. solution of pure crystallized zinc sulphate, having a specific gravity of 1.06. An amalgamated rod of pure zinc is then immersed in the zinc sulphate solution, and forms the negative pole of the cell. The flask need not be closed to the air unless it is wished that the arrangement should be portable, in which case the neck of the flask is closed, and the zinc rod is placed in a tube partially closed with some porous material. After a few days the E.M.F. acquires a constant value of about 1.39 volts, and varies only slightly with the temperature. When the current is not more than 0.001 ampere, the polarization of the plates rapidly disappears on breaking the circuit.—*London Industries.*

Guarding Moldering Bones.

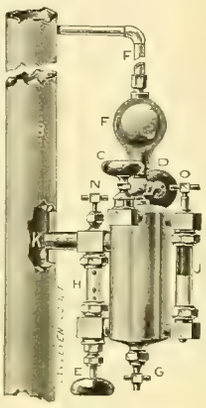
The sepulcher of the late W. H. Vanderbilt at New Dorp on the Staten Island railroad is under guard of six detectives night and day without ceasing. A sentry box stands near the grand receptacle for the dead, an amazing comment on the peace and security of the place. The men are kept on guard like soldiers. In addition to these human vigils, a system of signals or burglar alarms is added, which penetrates many different parts of the ground. At stated intervals these are set off by the single man on his six hours' turn of duty, and the reserve rapidly assembles at a given point. It is not dress parade, but a sort of drill that the chief detective exacts of the men whom he hires to guard this mausoleum from pillage. At night the watch is even more vigilant. When darkness brings greater danger from those who would steal the body for a ransom, a powerful flame is lighted in the cupola which shines out over the humble graveyard below. Into this dome one of the detectives must go every half-hour and touch another alarm which records the fidelity of those on duty. Every twelve hours the chief enters the building to see from this new electric register whether each man on duty during the night has gone his rounds at the prescribed moment. This precaution against theft furnishes many interesting reflections. The cost of guarding the remains of Mr. Vanderbilt amounts to a small fortune each year. The interest on the half million dollars said to have been expended on the twenty-one acres of ground and the mortuary edifice which adorns it is a big item. Add to this at least $30 a day for the detective guard which is kept constantly on duty, and it foots up a total of about $50,000 a year outlay to keep at rest the ashes of one man.

Typo, Telegrapher, Astronomer.

Some years ago, writes "Yusef" in the Detroit *Free Press*, of the late James Craig Watson, during the height of a warm senatorial contest at Lansing, I had occasion to telegraph some matter late at night, or rather early in the morning. The telegraph offices were closed, the operators gone home and there was no way to get the news on the wire. Professor Watson being in the hotel, I said to him that I had information which gave a new phase to the senatorial question and made an unexpected result apparent, that I much wished to communicate this to the readers of the *Free Press*, but on account of not being able to find an operator it was impossible. He said if I could admit him to the instrument he would telegraph for me. As there was a telegraph office in the hotel it was an easy thing to gain admission, and in a very short time the professor was at work sending my dispatch. The dispatch was sent without a break and with the rapidity of a trained operator. Professor Watson was there, fresh from Egypt, where he had been knighted and decorated by the khedive for measuring a meridian on the border of the great desert. He explained how he had learned telegraphing when a boy at Ann Arbor working his way through the university, and how useful the accomplishment had been to him, especially during his Egyptian experiences. Regarding Professor Watson as perhaps the brightest example of what the university can do for poor boys, who have intellect, but need culture and training, I looked up some of his old associates to-day and found J. Q. A. Frietchy, of St. Louis, Mo., member of the class of '58. "The first time I saw Watson," said Mr. Frietchy, "he was setting type in Gardner's printing office. He was, perhaps, fifteen years old, barefooted and ragged. Gardner pointed him out to me as a prospective student in the university and said he was the son of a poor laborer living in the woods four miles out of town. Hearing that his best chance of earning money to pay his way through the university was by becoming a printer, he solicited Gardner to teach him to set type Perceiving that there was something in the boy he put him at work and told him when he became useful he would pay him something. It didn't take Watson long to learn the boxes, and directly he was earning money. The next time Frietchy saw Watson he had a Latin book under the case and asked to be helped in a certain passage. Professor Brunow, quick to recognize the marvelous mathematical talent of the boy, gave him a place about the observatory, set him to making computations and paid him something for the work. Brunow also employed the boy to follow certain stars with the telescope, which he did night after night, Frietchy sometimes assisting. Watson worked his way through, the family moving into town, and the mother taking in washing to help buy bread, books and clothing. In time this boy, whose capacity in the study of languages was as great as in that of mathematics, became the most renowned astronomer of his generation. Without the privileges of a free education, which Michigan donates to all who care to seek her university, his genius would never have ripened into that exuberant flower of learning which the world so greatly admires.

The Detroit Lubricator.

We give herewith an illustration of the well-known Detroit lubricator. The introduction of sight feed lubricators wrought a revolution in methods of oiling, and now no first-class engine is without a lubricator that lubricates and shows that it lubricates. However, all sight feed cups are not first-class lubricators by any means. One will feed well, but is inconvenient to fill; others will appear to be tight under a heavy cold water pressure, but when they are filled with steam-hot oil they will leak almost like seives. All the points of a first-class lubricator have been studied by the Detroit Lubricator company of Detroit, Mich., for years, and the results are that they are turning out the standard lubricator of the day.



There is no field where a first-class lubricator is in greater demand than in the electric lighting field. Everything depends upon the proper performance of the engine, and one of the chief features in the proper running of an engine is the lubrication of the cylinder. Therefore, nothbut a first-class lubricator should be used in connection with an electric light engine.

Licensing Telephones.

At the meeting of the city council of Chicago last Monday night the matter of imposing a tax of $25 on each telephone in use in the city was settled by a communication from the corporation counsel to the effect that in his opinion the ordinance submitted was illegal. His communication is reproduced:

"In reply to your request I herewith submit my opinion as to the legality of the ordinance submitted relative to licensing telephones. The general incorporation law authorizes the corporate authorities of the city to license certain trade and occupations. These trades and occupations are specifically enumerated. It does not include in the enumeration telephones. It may be for the reason that the telephone as a system was not in public use at the date of the passage of the act.

"This specific enumeration of the power implies the exclusion of all others, and therefore the council has no right to impose a license on telephone companies

"I am of the opinion that the license can not be imposed under the exercise of the police power of the city. Under the exercise of the police power under legislative authority, unless such appears to have been the legislative intent, the law does not give the authority to the council to use the license as a mode for collecting revenue.

"Believing that the power to license is inhibited by the fact that the occupation is not directly or impliedly enumerated in the general incorporation law, and that it is not within the intent or boundaries of the police power, and that it does not come within the spirit or letter of the law authorizing the exercise of that power for the protection of the lives or health of the citizens, or the preservation of good order and public morals, I am of the opinion that the ordinance submitted is illegal."

Subsequent to the reading of this communication Ald. Hamline introduced an ordinance relating to the taxing of telephones, the figure being fixed at $10 per annum. The ordinance gets around the corporation counsel's opinion by making it a condition precedent to the granting of any rights to telephone companies that said companies first file a statement with the city collector showing the number of telephones in operation, and requiring the companies to get a permit from the commissioner of public works for operating such telephones, the city collector's receipt for $10 having to be produced at the time.

Personal Paragraphs.

At a recent meeting of the board of trustees of Cornell university, upon the recommendation of Dr. R. H. Thurston, Prof. Frank Van Vleck was promoted to the assistant professorship of industrial drawing and intrusted also with the direction of the post-graduate instruction in locomotive and railroad mechanical engineering.

The *American Miller* of the current month contains a fine engraving of Edward P. Allis, whose name is synonymous with first-class milling machinery machinery and a first-class engine.

R. N. Woodworth, representing the Julien Electric company of New York, was a caller at the WESTERN ELECTRICIAN office the early part of the week.

From the Pacific Slope.

The hotel De Cornado at Cornado beach, San Diego, Cal., is to have 500 rooms. It will be lighted with 1,600 incandescent lamps, and 20 arc lamps. The incandescent plant is to be on the hotel grounds, at the beach. The arc lights are to be furnished by the Cornado Electric Co., at San Diego (Indianapolis Jenney system). Six miles of cable have been laid across the bay of San Diego. The hotel is to have the latest improved annunciators, thermostats, return calls, fire alarm calls and all electric improvements. The hotel is owned by the same company that own the electric light station at San Diego. Their plant consists of two Buckeye engines, two 60-inch boilers, six dynamos, and twelve towers 125 feet high, with cranes and masts.

The Oregon Improvement company of San Francisco have had a Weston incandescent plant at their coal mine at New Castle, W. T., running for the last four months and they now intend to put in another at their mine at Franklin, W. T., and at their docks, shops aud depots at Seattle, W. T. They claim a saving of $350 per month over the old system of lighting by oil, and have a better and safer light.

The city trustees of Oakland, Cal., on the 6th, awarded the contract for lighting the city to the Oakland Gas Co. Gas will be used and the rate will be ten and a half cents per lamp per night. The action of the board of trustees is loudly condemned by the majority of the citizens. In this age of electric lights no city of 40,000 inhabitants should be without electric lights.

Santa Rosa is to have an incandescent plant of the Indianapolis Jenney System.

The residence of H. Hayward, at San Mateo, Cal., was lighted last week with a Brush incandescent plant.

Chico, Cal., is to be lighted by a Thomson-Houston plant.

The board of underwriters have notified the board of trustees of Alameda that they must increase their fire alarm system. So far their alarm has been given by voice to the station and then to the hand bell. They will receive bids for fire-alarm systems.

The electric light plant of the Jenney Electric Co. Indianapolis, at Alameda was sold last week to the city trustees for $40,000. This plant was erected by C. R. Lloyd, agent for the Jenney Electric Co., about a year ago, and Alameda is said to be the best lighted city on the Pacific slope. There are eleven 125-feet towers, four 100-feet towers, six 60-feet masts and twelve cranes. Each tower carries five lamps and a large number of store lights; two 12 x 16″ Buckeye engines are used and two 60-inch boilers. The Jenney Co. retains the right to nominate the electrician.

From Topeka, Kansas.

One of the finest electric light stations in the west is that of the Edison Illuminating company in Topeka, Kan., William D. MacQuesten of the Western Electric Construction company installed the plant from plans by J. H. Vail, General Superintendent of the Edison company of New York. They have six 500-light dynamos, driven by three Armington & Sims engines, 14½"x15". The boilers, 72"x18', were set by the Jarvis Engineering company, 81 Lake street, Chicago, with Jarvis patent furnaces, and are furnished with the National rocking grate bars. They are doing very economical work. The Baragwanath feed water heater and Worthington pump are evidence of care in selecting the best. In fact the station is a credit to the company, and all who took any part in its installation. The company have special reason to congratulate themselves on having a man so thoroughly competent as their superintendent, W. W. King, who has had extended experience in electric lighting. They have just ordered the fourth Armington & Sims engine, 14½"x15", and soon expect to double their present capacity. This large increase is brought about by the introduction of Sprague motors for power purposes, and the lighting of the streets, which the company have proposed to do on the municipal system. It is understood that Geo. F. Parmalee, president of the company, has recently come into possession of the street railroad and the running of their cars by electricity is contemplated in the near future. Mr. Parmalee, believing in the future of Topeka, has recently interested Boston capitalists, and the result is the purchase of nearly 2,000 acres of the choicest building land around the city. A park of nearly 400 acres is being laid out and streets projected. The improvement company have $2,000,000 capital. Mr. Parmalee is evidently the right man in the right place.

NEW ENTERPRISES.

A syndicate of New York capitalists is erecting a seven-story office building in Kansas City, Mo. The cost will be $350,000. The building will be one of the finest, if not the finest, in the city. A. Van Brunt, of Kansas City, is the architect.

Malcolm Holmes, of Kansas City, Mo., is about to erect a fine residence of three stories at a cost of $25,000. Electric appliances will be put in.

W. K. Eustis, of Minneapolis, Minn., is about to erect a store and flat at a cost of $7,000.

Savannah, Mo., is about to have a new court house of three stories to cost $10,000. It will be provided with electric appliances.

At Aurora, Ill., Milton Denny is erecting a residence at a cost of $3,000.

W. S. Ladd, of Portland, Ore., is putting up a building to be used as a wholesale store, at a cost of $45,000.

The Aberdeen Electric Light Co., of Aberdeen, Dak., will put in an electric light plant of about 250 lights.

At Plattsmouth, Neb., Dr. Murser, of Omaha, Neb., will erect a hotel of four stories at a cost of $100,000. Electric appliances will be put in. Dr. Murser is also erecting at Plattsmouth twenty tenement houses.

W. P. Herring is putting up a business block at Kansas City, Mo., at a cost of $15,000.

B. H. Brooks, of 30 Beal bldg., Kansas City, Mo., is the architect of a new office building to be erected in that city at a cost of $150,000.

Fooman & Parker, of Minneapolis, Minn., are erecting a carriage repository at a cost of $15,000.

A new college is to be erected at Salisbury, Mo., at a cost of $20,000. Dr. F. M. Clements will be in charge of the building.

Findlay, O., is progressing rapidly. A. L. Wetherell, of Massillon, and O. C. Dewey, of Wheeling, have just contracted to erect a wire nail factory which will employ over two hundred men; work will be begun at once on a factory for the Western Rapid Type-writer company, which will employ one hundred men; S. T. Dunham, of New York, has just filed a bond to have a street railroad on several of the most important streets completed by October 1st; another company will build another street railroad about one and one-half miles long to connect with West Findlay, and a contract has just been let for the erection of two hundred dwellings in various parts of the city.

The Chicago Auditorium building now under way promises to be a noteworthy addition to the magnificent buildings that excite the wonder of strangers and awaken the pride of residents. The value of the ground on which the building is to stand is $1,000,000; the cost of the building will be about $2,000,000. On three streets it will have a total frontage of 709 feet. It will be 144 feet high, of ten stories, and the tower will be 225 feet in height. The seating capacity of the auditorium will be 5,000 and the full capacity will be 9,000. Some fine electrical work will be seen in the building when it is completed

ELECTRIC MOTOR.

The Union Passenger Railway Co., of Richmond, Va., is laying about thirteen miles of track, on which cars are to be operated by electricity. The Sprague motor will be used, and the electric current is commnnicated from two wires overhead. An electric heater, invented by Dr. W. Leigh Burton, of Richmond, will be tried on the line, and it is claimed that it will prove very successful.

The opening of the electric street railway in Lima Thursday, is an event in the history of rapid transit in Ohio, and successfully inaugurates an enterprise of which that bustling little city may well be proud. Considering the fact that successful electric systems have been in use in a number of places for some years, it is strange that they have not come into more general use. With one already established in Lima and another soon to be inaugurated in Mansfield, the smaller cities of this state seem to be on a fair road to secure cheap and good street railways. It would not be a bad idea to give the system a trial in Cleveland.—*Leader.*

Butte, Montana, expects to have an electric street car system in operation before snow flies.

The Thomson-Houston Electric company has just placed on the market a line of motors from one to twenty horse power. One of the latter size has just been put in by the United States Construction company of Chicago.

All motors have been ordered off the wires of the Chicago Arc Light & Power company. This order was impelled by a number of accidents that have occurred through the carelessness of those attaching the motors. As soon as the new station of the company is completed, low tension currents will be provided for motor purposes.

ELECTRIC LIGHTING.

June 30th New Orleans witnessed the phenomenal fall of five inches of rain in about seven hours. The electrical accompaniment was very severe, thunderbolts having struck at many places in the city, fortunately causing no loss of life. The lightning played havoc among the electric lights and numbers of lamps were burned out. Telephone and telegraph circuits and instruments also suffered.

Another attempt to light the Hoosac tunnel by electricity is being made. Heretofore success has been hindered, principally, it is said, by the extensive volume of smoke always in the tunnel.

The Edison Light Fuel Gas company, of Grand Rapids, Mich., have purchased property at corner of Calder and Fulton streets, that city, on which they will erect a large building to cover the entire block. Work will commence on stringing wires within the next twenty days.

The Chicago Arc Light and Power company has absorbed nine different local electric lighting companies: Two plants of the local Thomson-Houston company; one of the Municipal Electric Light company; one of the Western Electric company; one of the Badger Electric company; two of the Wander & Abbott Electric company, and two of the Lake Gas company in the Town of Lake.

In the quarter ending July 1st, thirty-eight local companies were organized to use the Thomson-Houston system of lighting.

Detroit is talking of investigating charges of corruption made by a local paper in connection with the city electric lighting contract. It is said the newspaper which made the charges is disinclined to toe the mark and prove them.

The Chicago Arc Light & Power Co. is building a new station.

THE TELEPHONE.

A dispatch from New Liberia, La., dated the 3d, says: "A right of way over the roads of this and Martin's parishes and through the streets of this city and St. Martinsville was a short time ago granted Messrs. J. J. Fowler and L. T. Belt of New Orleans, for a system of telephone lines. Yesterday the materials for the construction of the lines arrived here and at other central points.

A Washington dispatch under date of the 8th says: The officials of the American Telephone company have called in all the stock sold by them and have refunded the money to the subscribers. They are now waiting for the confirmation of the Venezuelan concession, which is expected here on the 12th inst., and will begin operations on a new basis, issue their prospectus and place their stock on the market. Congressman Butterworth will sever his connection as president of the company as soon as the preliminary arrangements are effected and the concern is placed on its feet again. The old board of directors will remain.

The New Jersey Southern Telephone company, a concern recently organized, has been cited to appear before Judge Nixon, in the United States district court, at Trenton, for an alleged infringement on the Bell telephone patent.

On the first of the month the Chicago Telephone company had 4,500 subscribers. The increase during the year was about 500.

THE TELEGRAPH.

There were five car loads of telegraph supplies received here July 1st, says the Alexandria, Ga., correspondent of the New Orleans *Picayune*, consigned to the Western Union Telegraph company, which proves that Superintendent Littlefield intends to carry out what he said some months since to your correspondent—that in a short time he would give us a great improvement in telegraphic facilities.

The postmaster general has issued an order fixing the rates of government telegrams for the current year. The rates are the same as last year, but the basis of computation has been changed. Instead of paying rates on the exact distance from the place where the telegram is filed to the point of destination, the distance from state or territorial capital to state or territorial capital is computed and the tolls paid thereon. For instance, a telegram sent from any point in New York state to any point in Illinois the rate paid is based on the distance from Albany to Springfield. The following are the rates: 20 words or more for any distance up to 1,000 miles, 1 cent per word; 20 words or more for a distance of 2,500 miles or more, 2½ cents per word; 20 words or more for a distance exceeding 1,000 miles and less than 2,500 miles, add one-tenth of the rate for 1,000 miles for each 100 miles in excess of 1,000 miles.

A California telegraph operator substituted a large section of a wire fence for the telegraph wire lost in a storm, and the change, it is said, worked like a charm.

The Smith Brothers, capitalists of Boston, have begun work on a six-story block in Omaha, to be occupied by the Western Union Telegraph company.

The auditing committee of the Telegraphers' Aid Society, for the quarter ending June 7, 1887, report: Cash on hand at the commencement of quarter, $1,613,13; receipts from all sources, $500; disbursements for benefits, $183.72; current expenses, $69.73; balance in hand, $1,859.68.

The statement that the raft of telegraph poles towed by the tug Saugatuck from Alpena is the first raft of the kind ever heard of appears to be a mistake. Geo. Farnsworth, general manager of the Michigan Postal telegraph company, claims the honor of introducing the idea, having rafted poles for the Detroit & Milwaukee and the Toledo and Port Huron lines in 1858 and 1864, and those were the first Michigan cedar poles ever used exclusively on lines of such length.

Electrician Hamilton of the Western Union company is in Chicago testing the Brooks cables.

Miscellaneous Notes.

A company has been organized at Cincinnati, O., with $600,000 capital, to control the manufacture of electric locomotive headlights. It is stated that the company has purchased all the patents of both electric and steam appliances which have value for the purpose indicated. Messrs. Post & Co., of Cincinnati, are to be the exclusive manufacturers of the headlights.

It has been demonstrated that platinum wire may be drawn so fine as to be invisible to the naked eye, although its presence upon a perfectly white card can be detected by the touch, and can be seen by the aid of a small magnifying glass when the card is held in such a position that the wire casts a shadow.

At the Pacific Iron works they are building a plant of the Rae electric system of working ores for the Christy mill, Utah. This is the same system which has been in use for the past three months at the Douglas mill, Dayton, Nev., where they are working 100 tons of ore per day. Mr. Douglas states that the process effects for him a saving of some $6,000 a month. Several other mills will soon be fitted with appliances for working ores by this system.—*Mining and Scientific Press.*

We are informed by the Anglo-American Brush Electric Light corporation that they have arranged to accept one pupil without premium from the City Guilds institute on the recommendation of Professors Ayrton and Thompson, subject to certain conditions of eligibility. John Rance, Jr., is the first nominee, and future vacancies will be similarly filled.—*London Industries.*

The length of the telegraph wires connecting the different fire engine houses in Paris is about 350 miles. The total number of fires in 1886 was 953, exclusive of 1,524 fires in chimneys. No fewer than thirteen of these fires were in theatres and cafés-chantant. One hundred and seven fires were caused by the upsetting of lamps. The total loss was about $1,240,000.

On the 4th of July Emile Coldeway and Claude Summers, two boys of Louisville, Ky., took refuge in the hollow trunk of a huge sycamore tree during a heavy thunderstorm; a thunderbolt struck the tree and instantly killed both boys. The only mark found on Summers' body was on his neck, where the electricity had melted his gold collar button. On Coldeway was found a small mark on the neck and one on the left hip.

Business Mention.

Austin, Tex., is to have an incandescent electric light plant of a capacity of 5,000 lights to be in operation about September 1st. The whole is to be of the most improved construction, and no expense is to be spared to make it first-class in every way. The old Water & Arc Electric Light Company have reorganized as the Austin Water, Light & Power Co. The contract for the steam plant has been placed with the Pond Engineering company of St. Louis, and includes four 80-horse power steel tubular boilers, all to have Jarvis patent furnaces and National rocking grates; also, one 328-horse power Lowe feed water heater and purifier.

The Parsons, Kas., Light & Heat company have contracted with the Kansas City branch of the Pond Engineering company, for a complete steam plant to operate the Thomson-Houston system of electric lights. The order includes one 60-horse power Armington & Sims engine, one 70-horse power steel boiler, Lowe feed-water heater, and Blake pump.

The arc lighting plant of the Nevada, Mo., Electric Light Co., is to be greatly enlarged at once. An 80-horse power Armington & Sims engine, steel tubular boiler, feed-water heater, Blake pump, pipe work, etc., have been ordered of the Pond Engineering company, St. Louis, who are to deliver and erect the same ready for service.

The advance sheets of the new catalogue of the Fort Wayne Jenney Electric Light Co. of Fort Wayne, Ind., have just come from the hands of the printers. The incandescent system of this company handsomely illustrated was shown in the last number of the WESTERN ELECTRICIAN. In addition, the company supply an arc light system, and all accessories for the installation of either systems, motors, the Star iron tower and patent mast arm. A portion of the catalogue is taken up with testimonials from as handsome a clientage of patrons as could be desired.

The Jarvis Engineering company of 81 Lake street, Chicago, will set the boilers for the Thomson-Houston Electric company, San Antonio, Tex.

The Jarvis Engineering company is out with a handsome new catalogue, showing the method of setting boilers on its system. The company is prepared to furnish complete steam plants, including engines, boilers and the Jarvis setting, Sheffield or National rocking grate bars, Shepard's improved power pump, and, in fact, everything that goes to make up a first-class steam plant. The catalogue has some very interesting tests for economy of the Jarvis system of setting over the common setting.

The Thomson-Houston Electric company has just let a contract for an addition to their factory, which will give them 38,000 feet of floor room.

The Thomson-Houston Electric company has recently received the following orders: From Kansas City an order for an additional 300 lights, making the total number in use there 800. From Stockton, Kan., a 50-light plant of arc and incandescent lights. Marshalltown, Iowa, a contract for 600 incandescent lights. Bismark, D. T. has just started a plant of 50 arc lights and is installing a plant of 600 incandescent lights. El Paso Electric Light and Power company of Colorado Springs, a 50-light plant. Boulder Electric Light company of Boulder, Colo., a plant of 400 incandescent lights. Marion, Kan., a combined arc and incandescent plant. Hastings, Neb., 800 incandescent lights. Lake View, Iowa, 150 arc lights and 1600 incandescent lights. Junction City, Iowa, 400 incandescent lights. Parsons, Kan., 30 arc lights. Olympia, W. T., 50 arc lights. Marion, Ind., 50 arc lights.

Since the last issue in which the police patrol system of the Police Telephone and Signal company was shown, an order has been taken for 30 stations complete for Boston. Among other orders recently received is one from Milwaukee, making a total of 30 stations within three months. One from Omaha making a total of 27 stations. Twenty stations were ordered and the day after the system was put in use seven additional stations were ordered. An order has also been received for six stations for Joliet, Ill., twelve stations for Hyde Park, and another dozen for Detroit, Mich.

The order for a very large amount of cable for police and fire alarm purposes in Detroit was captured by Clark B. Hotchkiss for Day's Kerite.

The Colorado Electric company has been formed in Denver to operate 7,500 Westinghouse lights. Fred Degenhardt, western manager for the Standard Underground Cable company, secured a heavy contract for cables, aggregating forty-eight miles of wire, from the Colorado Electric company.

Electrical Patents.

Issued July 5, 1887.

Nos. 365,776 to 365,781 were granted James W. Bonta, of Philadelphia, assignor to American National Telephone Company, for Telephone Transmitters.

The inventions in these six patents relate to the carbon electrodes which are in some instances arranged in multiple arc, each branch of local circuit being supplied with a separate battery and induction coil. The main feature where multiple electrodes are used consists in securing uniform variations of pressure at each contact.

365,787. Electrical Block System for Pneumatic Dispatch. Andrew Bryson, jr. and Henry S. Mudge, Brooklyn, N. Y.

365,792. Apparatus for Measuring Electricity. Jules Cauderay, Paris, France. The apparatus is designed for measuring the current strength of electricity generated by alternating machines. Its operation depends upon the attraction and repulsion of wires when traversed by currents.

365,842. Electric Cartridge. Edgar A. Monfort, New York, N. Y.

365,911. Police-Telephone System. William H. Eckert and John A. Seely, New York, N. Y. The invention is an ingenious system for communicating from headquarters with policemen throughout the city.

365,935. Electro-Magnetic Annunciator Drop. Joseph J. O'Connell, Chicago, Ills. The electro-magnet core is permanently magnetized, and when demagnetized by the current allows the iron shutter to fall.

365,978. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J. Two or more dynamo electric machines are connected in series and a circuit from these machines extends to sub-stations at each of which feeding circuits are taken off to supply that particular district.

365,982. Transmitter for Printing-Telegraphs. Stephen D. Field, New York, N. Y.

365,994. Printing Telegraph. Clarence L. Healy, Brooklyn. Resistance is introduced into the circuit before the relays are shunted to prevent excessive flow of current.

366,021. Electro-Magnetic Motor. Henry M. Paine, Newark, N. J.

366,034. Galvanic Battery. Carl Seiler, Philadelphia, Pa. By a lazy tongs movement the electrodes may be raised from or lowered into the solution. The cells may be readily connected in multiple or in series.

366,058. Electric Belt. Robert E. Williams, of Dallas, Tex., and Turner G. Hammer, of New Orleans, La.

366,124. System of Electric Distribution. James F. McElroy, Lansing, Mich. Manual switches are placed at the terminals of a local lamp circuit and are so arranged that connection may be made with the positive or negative service conductor. The lights may be thus turned on or off at either end of the local circuit.

366,154. Signal Box. Henry A. Chase, Stoneham, Mass. The patrolmen are provided with keys on which are placed insulating strips. Upon inserting a key in any box, the box number and the particular number of the key inserted will be given at the central station.

366,164. Electrolytic Vaporizer for Medicinal Purposes. Manly M. Gillam, Philadelphia.

366,166. Printing Telegraph Transmitter. Clarence L. Healy, Brooklyn.

366,173. Junction-Box for Electric Conductors. John Kruesl, Brooklyn.

366,174. Electrical Conductor. John Kruesl, Brooklyn.

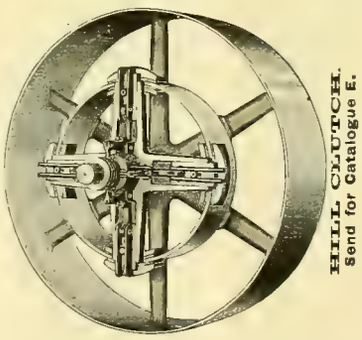
366,176. Thermotic Circuit-Closer. John C. Mackey, Phœnix, N. Y.

366,178. Printing Telegraph Receiver. Henry Mahnken and Clarence L. Healy, Brooklyn.

366,184. Electric Rock Drill. Lucius J. Phelps, New York, N. Y.

366,190. Electric Telephony. Alfred G. Safford, Washington, D. C. The invention relates to reed electric telephones and depends for its usefulness upon the fact that the free vibrating reeds are to be attuned to different rates of vibrations.

366,192. Polarized Relay. Granville T. Woods, Cincinnati, Ohio.



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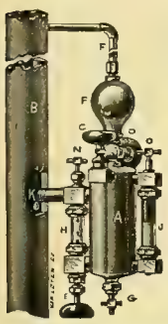

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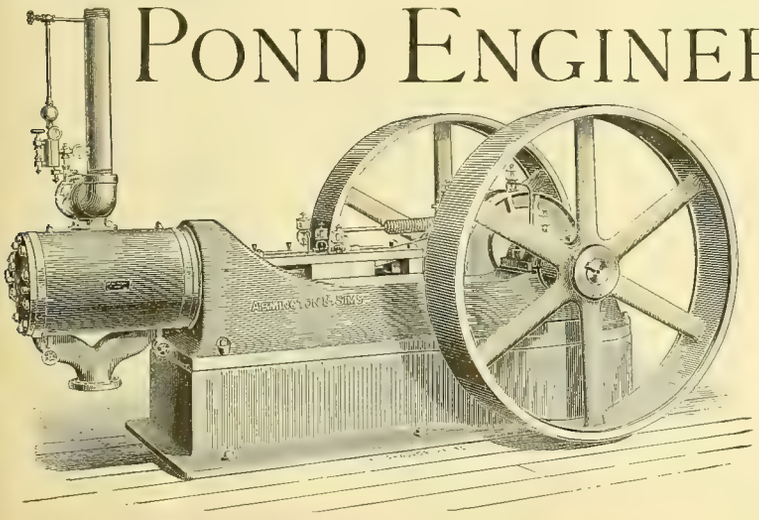

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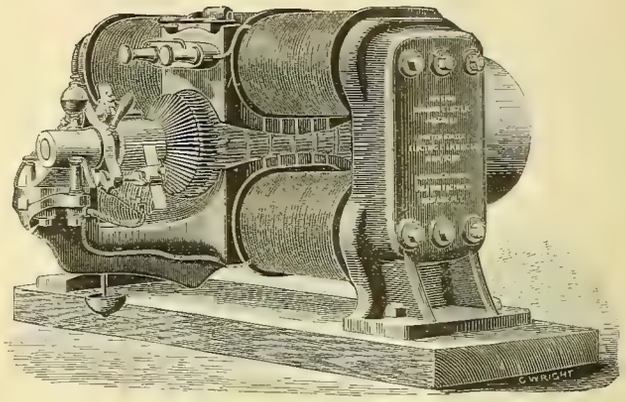

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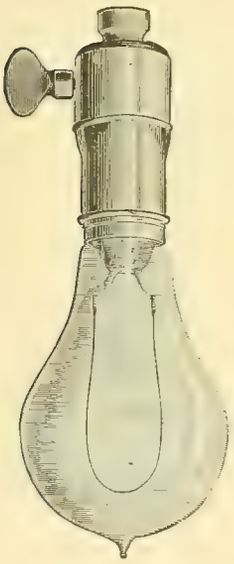

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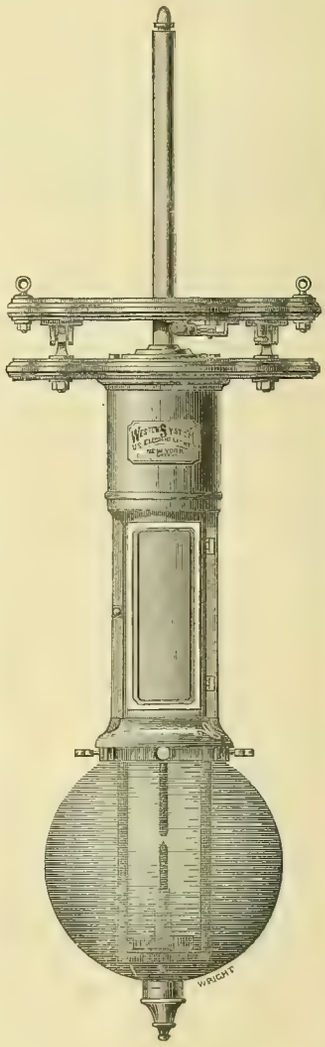

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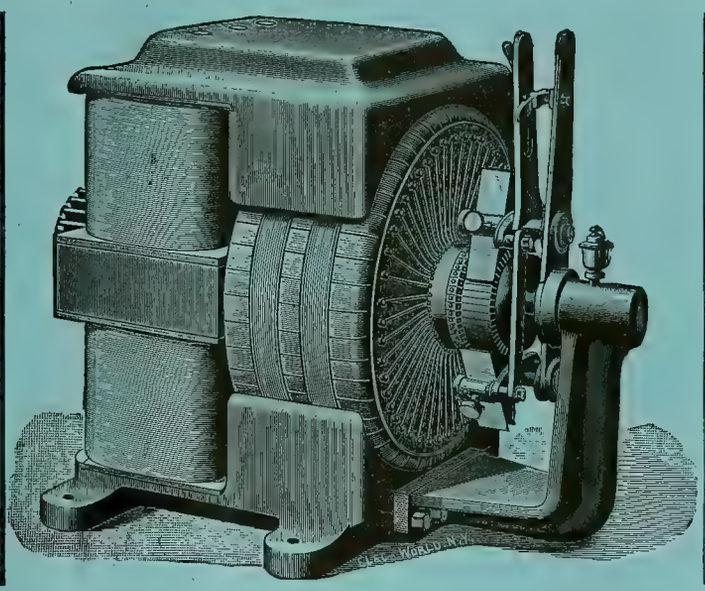

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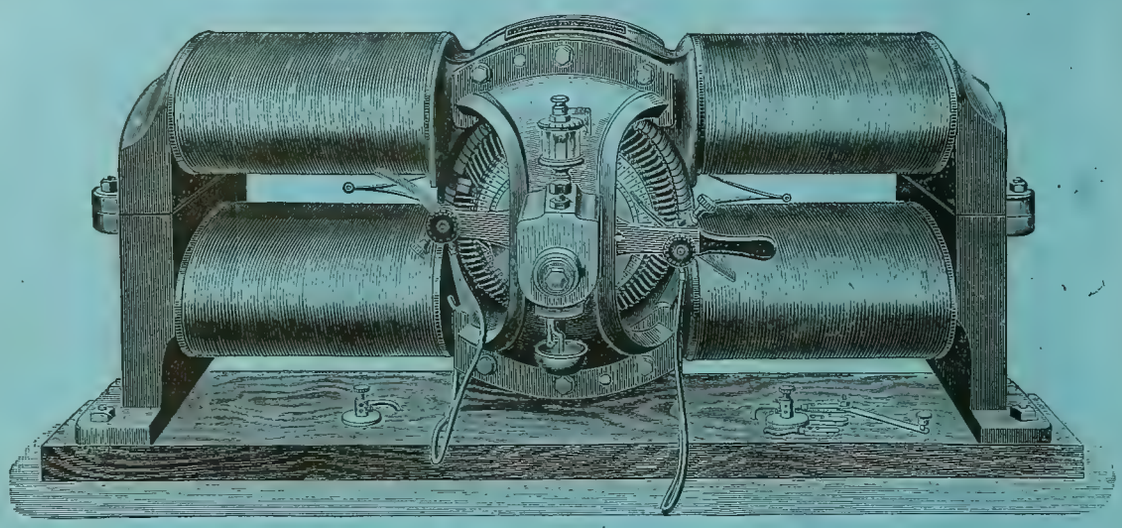

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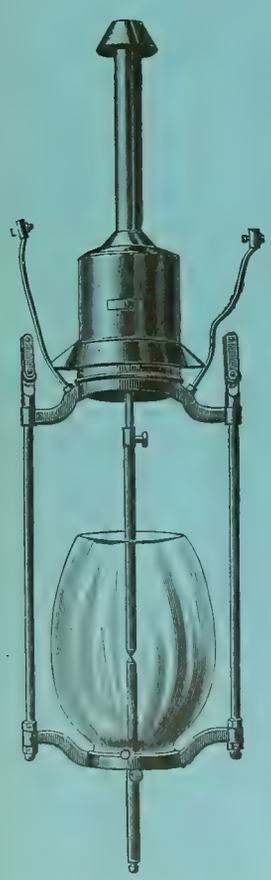

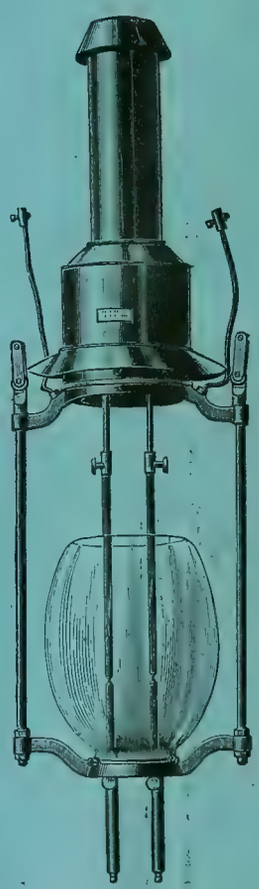

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Vol. I. CHICAGO, JULY 23, 1887. No. 4.

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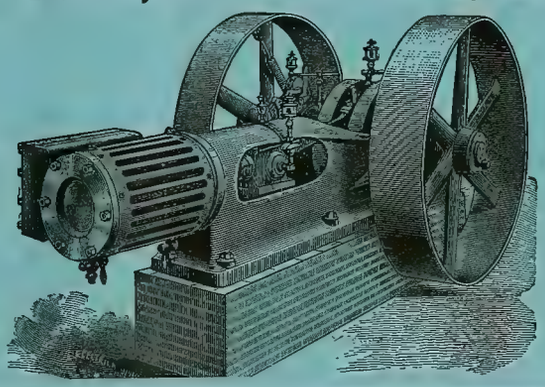

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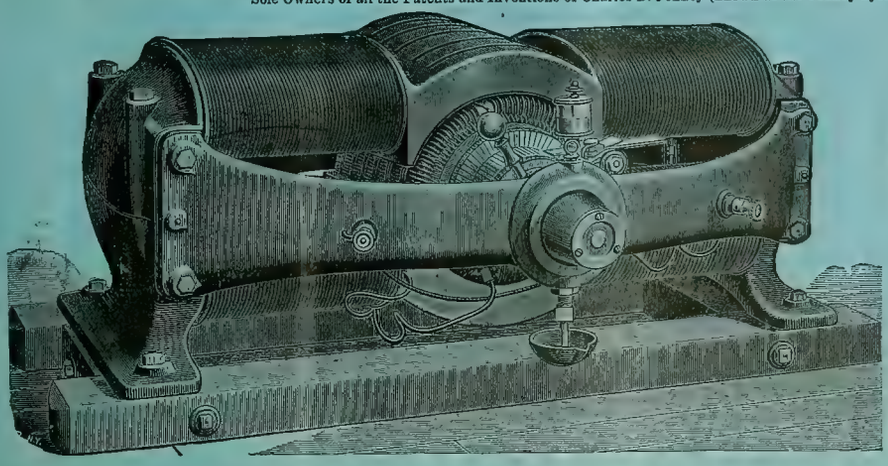

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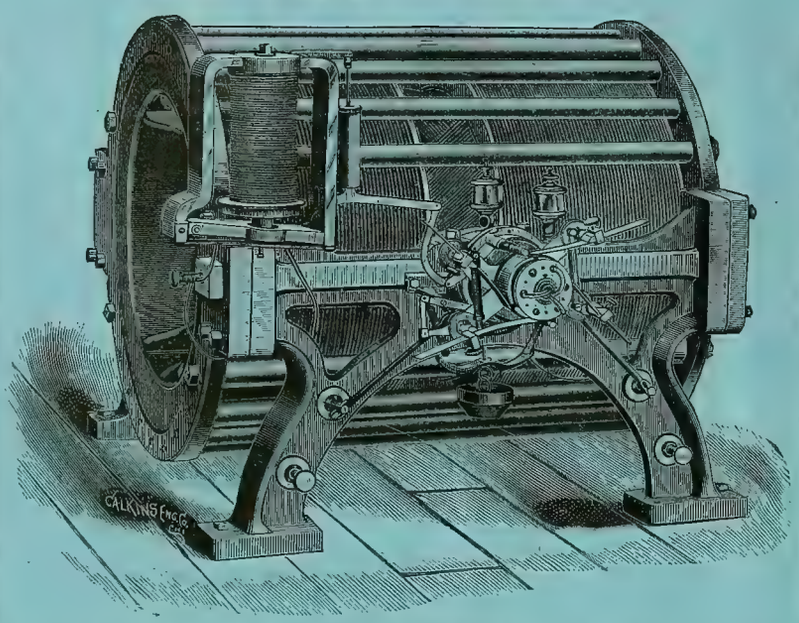

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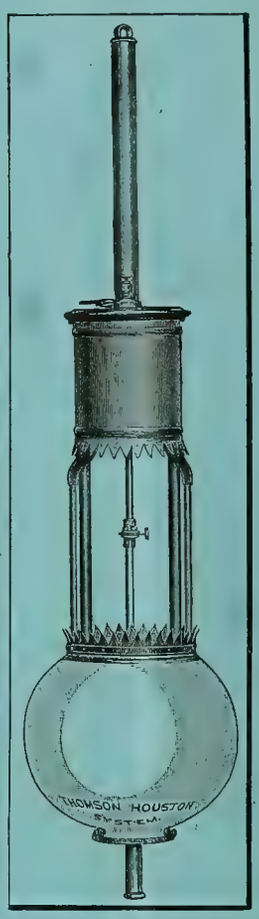

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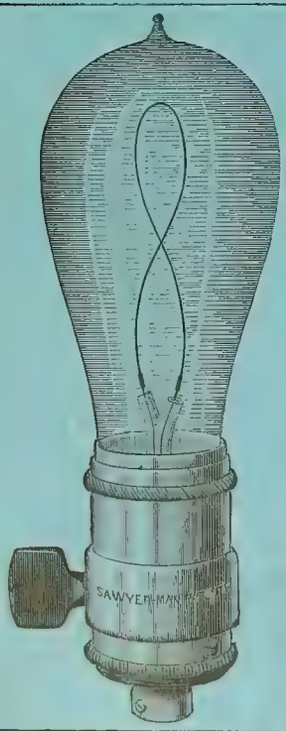

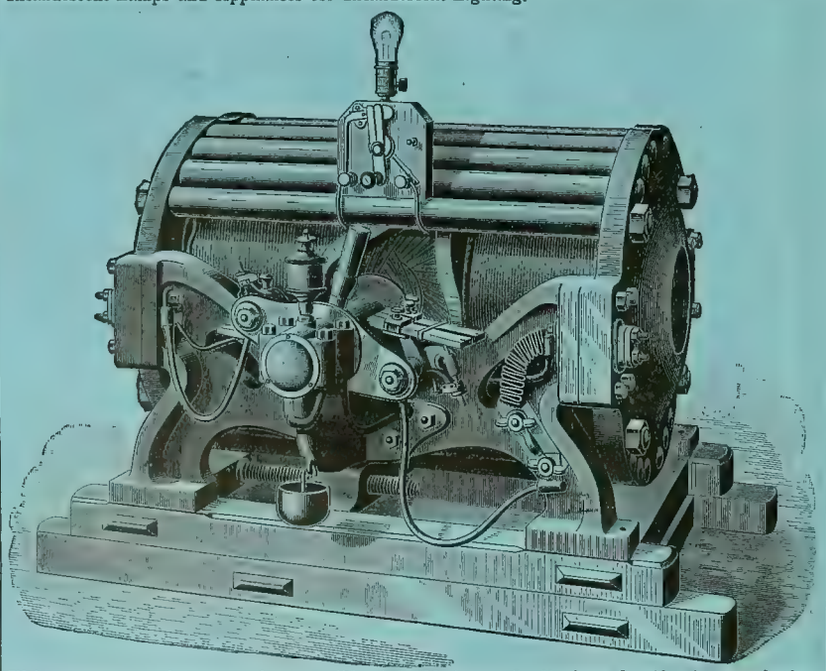

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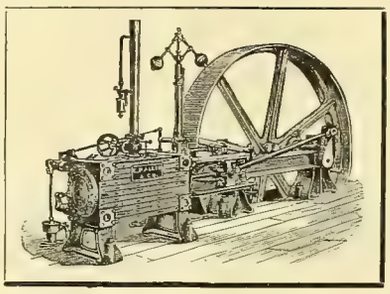

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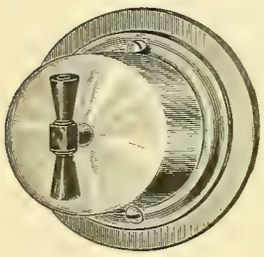

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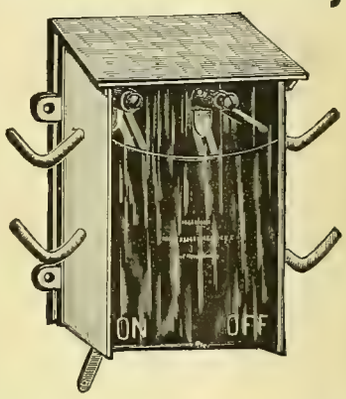

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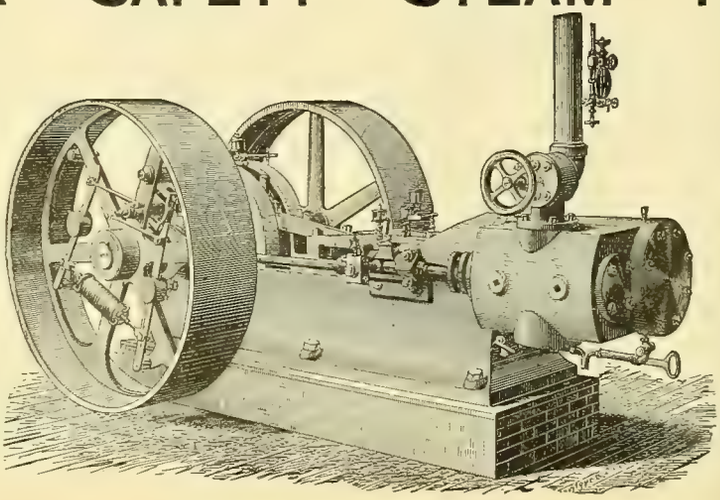

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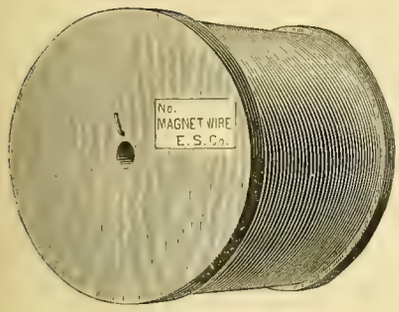

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THE WESTERN ELECTRIC COMPANY'S

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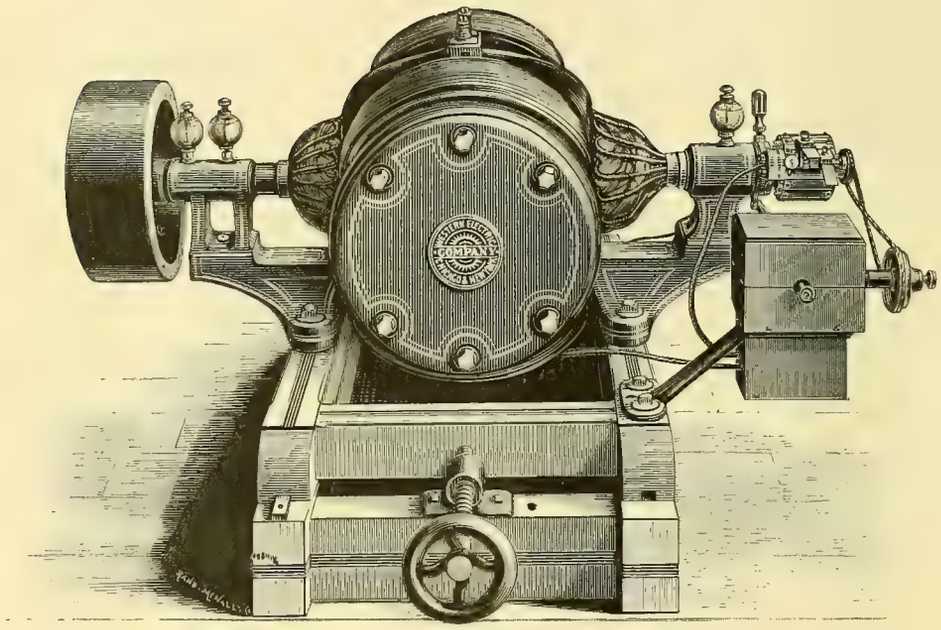

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Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, JULY 23, 1887. No. 4.

Method of Making a Cable.

Whiz-z-z—bur-r-r—clatter-r-r—buz-z-z! These were the only distinguishable sounds that greeted the WESTERN ELECTRICIAN representative as he was ushered into the insulating room of the Western Electric company, Chicago, bound on seeing a telephone cable pass through all the processes of manufacture from the bare copper wire to the reel on which a huge cable had been shipped away as he entered the factory. Amid the clatter of this insulating room it is well-nigh useless to attempt to listen to explanations and the eyes must convey the information to the brain. We will watch the process of making what is known to the trade as a twenty-five wire cable. The naked copper wire is brought on a reel to a winding machine. This is the machine that prevents the questions that would otherwise be asked—not that any one machine is particularly noisy, but one machine in conjunction with a hundred others succeeds in creating a second Babel. In an adjoining room are the braiding machines which serve the same purpose as the winding machines, differing, however, in the character of the work they turn out. In the case of the winding machines the covering of cotton or jute is wound round the wire, and in the case of the braiding machines, the covering is braided about a wire as a core. To those unaccustomed to a braider the sight is a novel one. The parts of the machine carrying the thread follow such serpentine courses, flash in and out, double on their own courses and engage in such convolutions that the uninitiated stranger awaits with abated breath the moment when the machine will twist itself into such knots that there will be a general smashing on all sides. The catastrophe does not occur. Now and then a thread breaks; the girl in charge who has been coolly eyeing the stranger, calmly halts the crazily whirling machine, as calmly reunites the ends of the thread and starts the machine in its whirligig course again. But it is through the winding machines that the bare copper wire passes until from one end to the other it is covered with its cotton or jute dress. As fast as it is dressed—so to speak—it is wound on a reel to await the next step in the process. Twenty-five of these wires are covered or insulated, as the technical term is, and then the whole twenty-five are bound together and covered in the same way as the first wire. At the conclusion of this step in the manufacture, the cable, for that name can be given it now, resembles a rope. The cable then goes to another part of the building where it enters a huge oven and is thoroughly dried in order to get rid of that bane of a good cable—moisture. After an exposure of about twelve hours to a heat of about 180 degrees Fahrenheit, the cable is ready for its bath of paraffine, the purpose of which is to exclude any moisture that might tend to work back into the cable at any spot. Into a large iron tank partially filled with melted paraffine which, so far as appearance goes, resembles water, the cable is placed, and it receives a thorough soaking. When the melted paraffine has penetrated every pore of the cable, the latter is replaced in the oven for another hot air bath, but the ends of the cable are brought through perforations in the side of the oven, for a purpose to be explained, leaving the coil on trucks on the oven floor. This cable, may be several thousand feet long, is to be drawn through a lead pipe, which, by the way, is of special composition for this purpose. The lead pipe is made in lengths of 125 feet or more, and the casual visitor may puzzle his brain sometime before arriving at the method by which that cable is to be drawn through that pipe. The lengths of pipe are laid side by side on the floor of the room in which these operations are carried on. The ends of the pipe are not soldered together and up to this point we have a continuous cable, and a number of pieces of lead pipe whose aggregate length is the same as that of the cable. The next step in the process is an exceedingly simple one, and yet leads the way to the solution of what looked like a complex problem. One of the employes takes a wad of cotton and attaches to it a fine, light, but strong string, which in turn is connected with a rope, and that in its turn to one end of the cable which is still in the oven. The wad of cotton is inserted in the end of one of the lengths of pipe, a small air pump is attached to the other end, a handle is worked and as the air in front of the cotton is exhausted, the atmospheric pressure behind forces it through the pipe in a flash — or to be less technical, the cotton with its string attached is "sucked" through the pipe. The rope is drawn through the pipe and after it follows the cable. While

FIG. 1—METHOD OF MAKING A CABLE.

the rope is going through the first length, the cotton and string are put through the second length of pipe, and by the time the cable is on its way through the first length, the cotton and string are in the third length of pipe, and the rope started on the second length. When the cable is through the first length of pipe it follows the rope and thread all the way through the other lengths. The joints in the pipe are then soldered making the pipe with its core of cable continuous for the desired length.

Again another paraffine bath. But this time the melted paraffine is forced into the pipe, under a carbonic acid gas pressure of from 80 pounds to 140 pounds. The cable is once more treated to a hot air bath, and is then wound on a reel and tested, and the wires at either end are so marked with tags as to be readily identified.

These cables are used aerially or underground or for submarine purposes. When one of these cables is used aerially, it is with the idea of carrying a number of wires within a small compass, thus doing away with obstruction to light, and not overloading the poles that support the wires. Aerial cables are generally swung from a wire that carries the cable and saves the latter from pulling apart from its own weight. Underground cables are designed to get rid of the annoyance of wires strung on poles, while submarine cables are used for crossing bodies of water where wires strung above the surface would be inadmissible. Submarine cables are sometimes armored, that is, are wrapped with a heavy wire to secure immunity from damage by chafing on rocks or having anchors of vessels dragged across them.

The illustrations given herewith will serve to give a clearer idea of the subject matter. The group of cuts showing the cross-sections of cables exhibit the different kinds of cables manufactured at the establishment visited. Fig. 3 shows an aerial cable with its insulation of paraffine and the sheath of lead pipe; Fig. 4 differs from Fig. 3 in its armor of wire to protect it from injury; Fig. 5 is another form of aerial telephone cable with an induction wire through the center; Fig. 6 shows the induction wire, the copper conducting wires, the insulation of cotton or jute, the paraffine insulation, the sheath of lead pipe and finally the armor of wire; Fig. 7 shows a telegraph cable which is used under water or underground and also shows the characteristics of other cables already described of the paraffine insulation, the sheath and the armor. Fig. 2 illustrates the hanger used to support aerial telephone cables, while Fig. 1 shows the terminal to a cable.

Ignition of Fuel by Electricity.

At the convention of the Master Mechanics' association last month, Mr. Ettinger, of the committee on "Locomotive Preparation," read the appended communication from M. J. Leonard, superintendent of telegraph, at Richmond, Va. Mr. Ettinger explained that, in connection with the subject of firing up locomotives, he had inaugurated a series of questions to several electricians, asking whether it would not be practicable to do away with the use of wood entirely, and either use some form of electrical current or petroleum gas. Mr. Leonard replied:

"Referring to your inquiry of a few days ago upon the practicability of utilizing electricity for the purpose of starting the fires of locomotive engines in round-houses, I beg to say that after some consideration of the subject it appears to me as being entirely feasible at any place where electricity is now used for lighting purposes. By attaching flexible wires to the main circuits in such a manner as to render it portable, I think that a simple apparatus could be devised in such a manner as to heat to combustion within a few minutes enough fire to enable a blower to be turned on and the fire forced enough to generate steam, which would be an improvement in time and expense on the present method of using waste and wood.

"To prove the practicability of this idea, I would call attention to the fact that the Cowles Electric Smelting & Aluminum company have for the past two or three years been producing aluminum and its alloys in the electric furnace at Lockport, N. Y., and Cleveland, O. This has

been done by passing a current of electricity of large quantity and small pressure through carbon electrodes three inches in diameter to thirty inches long. This current is sufficient to melt 18 lbs. copper, 14 lbs. aluminum, oxide and several pounds of charcoal, forming a bright and crystalline metal in one hour. If, therefore, so refractory a substace as corundum, as well as solid copper, can be melted in one hour, it seems to me, there should not be much more difficulty in inducing the combustion of coal with the electric current in at least one-tenth of the time.

"I have been so busy since you brought the subject up that I have been unable to think the matter over as much as I would like with reference to the best form of apparatus for this purpose. I have no hesitation, however, in saying that the most economical results would be obtained from the low tension or large quantity (incandescent lamp) current, besides being much safer to handle than the high tension (or arc light) current. At the same time, as there are very few railroad shops supplied with the incandescent electric lamps, the arc lamp seeming to have the preference, it would be interesting to consider under what conditions the arc lamp current could be used.

"1. It should be rendered perfectly safe by being heavily insulated to prevent short circuiting through the person handling it

"2. It should be fitted with flexible wires so as to reach any part of the roundhouse. And

"3. It should be small enough to readily pass in and out of the furnace door.

"These it seems to me are the most essential qualities that such an apparatus should possess, and I believe can be readily combined by the use of a V shaped frame with three pairs of carbons connected in series and switch placed high enough on the two conductors to cut off the current from that part of the apparatus likely to be handled. Of course it would be necessary to properly insulate the carbons, the first charge of coal, and the apparatus itself from the end of the boiler in order to prevent the loss of current to and through the ground. This could be done by using a plate of say slate or asbestos for the base of apparatus, long enough to hold the coal to be ignited. With such an apparatus as this I have no doubt satisfactory results can be obtained, and thus lead to the utilization of electricity in a new field of work."

Chicago's Electric Light Plant.

The specifications for the electric light plant to be used in Chicago for lighting the bridges and viaducts of the river from Halsted street bridge on the north branch to Halsted bridge on the south branch and on the main river east to Rush street have just been completed by City-electrician Barrett. Bids will be received at the office of the commissioner of public works, Chicago, at 11 o'clock A. M. July 30th. Bidders will be required to furnish a certified check for $1,000 or satisfactory bond for the same amount guaranteeing faithful performance of the contract. The dynamos shall have capacity to operate one hundred double carbon full arc lamps over a circuit of ten miles. Dynamos are to be mounted on adjustable base with belt tightening apparatus. Each dynamo is to be pro vided with approved lighting arresters. Each dynamo is to be provided with an automatic current regulator to fully govern the current and arranged so that the steam power required will be in proportion to the number of lamps in operation.

Ammeters are to be furnished with each dynamo. The lamps are to be double full arc of nominally 2,000 candle power each. All lamps are to be weather proof or provided with suitable hoods. The globes are to be quarter-ground. Fixtures to place the lamps on lamp posts where directed will also be furnished, and they must be placed in such a manner as not to interfere with the use of posts for gas lighting. Suitable fixtures must also be provided for suspending lamps on the viaducts as may be required. A switch board is to be provided of suitable size and arranged so that a circuit from one dynamo may be changed to any other dynamo while in operation without opening the circuit, or so that any one dynamo may be changed from one circuit to another without opening the circuit. Bidders will give the current required for each lamp in ampères and volts.

The plant shall be placed in the basement of the building at the location noted above, and cables shall be brought from the switch board to the street line, thence underground across Clinton street to north wall of Washington street tunnel, thence along wall to light shaft, thence through light shaft to dock line elevation on both

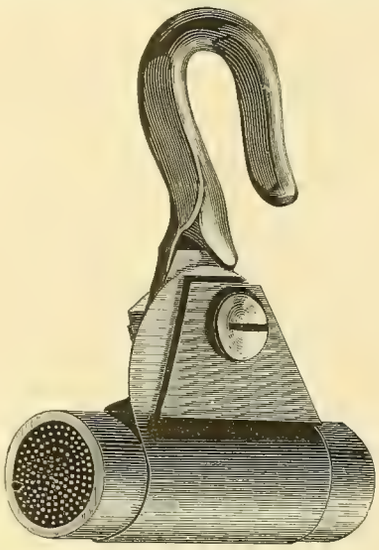


Fig. 2.—Method of Making a Cable.

sides of the river. Cables are to be dropped into the river and suspended below frost line so that they may be removed readily should it be found necessary in case of dredging or repairs to line of docks. The cables are to be brought up on the bridge abutments and protected in extra iron pipe from below frost line to at least ten feet above sidewalk. Where cables go underground and along the wall of tunnel they must be incased in iron pipe. All cables to be furnished shall be iron armored. All cable conductors are to be of a size equal to No. 5 B. & S. gauge. In running a circuit from abutment to viaduct and return No. 5 underwriters' wire insulated, or other equally good insulation and conductivity, may be used. Insulation of cables to be guar-

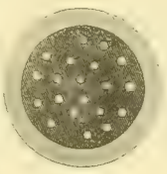


Fig. 3.

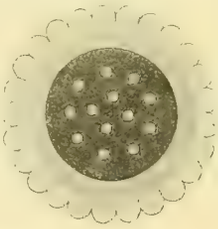


Fig. 4.

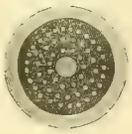


Fig. 5.

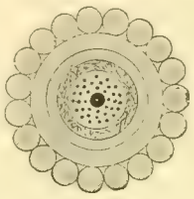


Fig. 6.

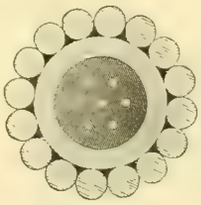


Fig. 7.

Method of Making a Cable.

anteed to be not less than 500 megohms. Where a street intervenes between bridges and viaducts armored cable or insulated wire in iron pipe may be used under the sidewalk space.

Bidders are to furnish a sample of the cable they propose to furnish. They will estimate on furnishing the armored cable required, including all labor, per mile. In all respects estimates are to include everything to make the plant complete in every respect, including the services of an expert for at least thirty days after starting up.

The steam plant to be used in connection with the electric light plant will consist of a steel boiler 72″ x 18 feet, containing 66 four-inch tubes, and an automatic engine that will yield 125 horse power at one-fourth cut-off and 80 pounds steam pressure.

American Institute Electrical Exhibition.

Application blanks for space for the display of electrical appliances at the American Institute Electrical exhibition, to be held in New York City, September 28th to December 3d, next, are now being sent out by the secretary, Joseph P. Wetzler. The office of the secretary is at room 175 Potter building, and the exhibition buildings are on 2d and 3d avenues, between 63d and 64th streets.

The classification of the electrical exhibition shows six sections as follows:

Section I. — *Production of Electricity.* 1. Dynamo and magneto-electric machines. 2. Primary batteries. 3. Thermo-electro apparatus. 4. Static electric apparatus.

Sec. II.—*Apparatus Requiring Powerful Currents.* 1. Electric motors and transmission of power. 2. Electric railways. 3. Storage batteries. 4. Electric illumination. 5. Electro metallurgy and electro-chemistry. 6. Miscellaneous application of powerful currents.

Sec. III.—*Apparatus Requiring Comparatively Weak Currents.* 1. Fire and burglar alarms, annunciators, watchmen's time detectors, electric bells, etc. 2. Electric telegraphs, telephones, microphones, photophones and radiophones, and other apparatus for electrical communication. 3. Electric registering and signaling apparatus. 4. Application of electricity to the mechanic arts. 5. Applications of electricity to heating and ventilation. 6. Electric clocks and time telegraphs. 7. Electric medical apparatus of all descriptions. 8. Application of electricity to writing and printing. 9. Electrical toys. 10. Miscellaneous applications of small currents.

Sec. IV. — *Electric Conductors.* 1. Electric light and power conductors. 2. Telegraph and telephone wires and cables. 3. Insulating materials, electrical joints and connections. 4. Electric underground wire systems.

Sec. V. — *Electrical Measuring Apparatus.* 1. Voltmeters and ammeters. 2. Galvanometers, rheostats, etc. 3. Condensers, switches, keys, etc.

Sec. VI. — 1. Historical and miscellaneous exhibits. 2. Educational and bibliographical.

In addition to a general committee, special committees have been appointed on finance, space,transportation, electrical installation, entertainment, exhibit, correspondence and publication, and historical apparatus.

A Time System for Railways.

One of the exhibits at the National Educational exposition just closed attracted considerable interest among the many delegates attending, and the general verdict seemed to be that it should be adopted in every school building throughout the land. We refer to the system of synchronous time, consisting of a number of self-winding clocks connected with a large regulator or master clock by a small wire that every hour conveyed an electric impulse to every clock in the circuit, setting the hands correct with itself should any of the smaller clocks have gained or lost time during the hour. This system is also peculiarly adapted to railways, giving the same time at every station on an entire line once every twenty-four hours and showing the agent at every station how many seconds his clock has gained or lost, thus enabling him to regulate it with the master clock in the general office of the road. Were this system adopted by railway companies generally fewer accidents would happen and there would be no excuse for an employe's watch being off time, as now often occurs, and the companies would set an example in furnishing a reliable system of time that the trainmen and other employees would not be slow to follow.

The National Telephone association has decided to hold its meeting at Pittsburgh, commencing September 26th.

The Bidwell Conduit System.

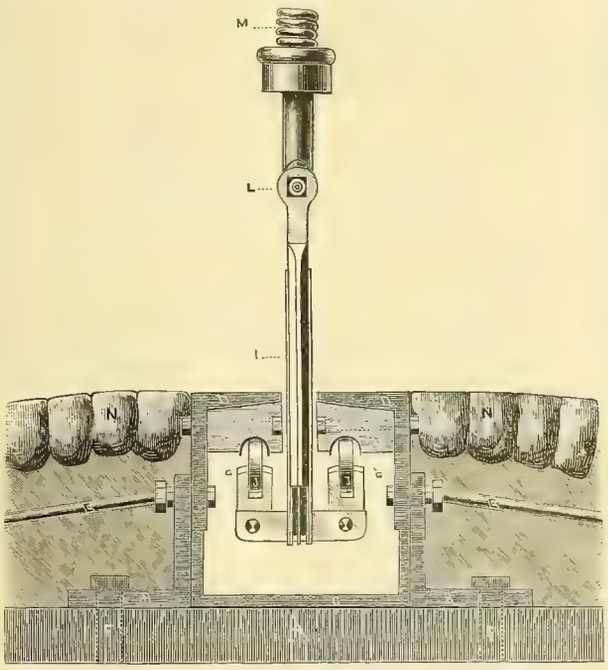
The feasibility and practicability of electricity for the propulsion of street railway cars has been thoroughly demonstrated and is no longer in doubt. Its application for this purpose has been a subject of study and experiment for many years, resulting in a good degree of perfection; sufficiently so as to make its use in this connection more economical and more desirable than any other motive power. It is noiseless, gives any desired speed, admits of cars being run in opposite directions upon the same track, or changing the direction of a car at any point on the line by simply reversing the current switch.

In every town or city where there is population enough to warrant the operation of a street railway, electricity is being used for lighting purposes. With the Bidwell system of conduit appliance the same current can be used for lighting and for motive power on the cars, thereby saving in the establishment of plants for source power and in the conveyance of the electrical currents.

The construction under this system is shown in the accompanying engraving, which represents a transverse section, and consists of the conduit placed between the rails and beneath the surface, six inches wide and eight inches deep, with a slot or space five-eighths of an inch wide at the surface, running parallel with an opening into the conduit.

A represents the cross tie upon which the conductor is placed, NN the pavement; *B B* angle braces; *C* lower conduit case; *D D* upper conduit case; *E E* stay rods.

The electrical conductors *G G* are concave and suspended under the surface plates *D D*, but properly insulated from them by the insulating wood *H H*. Thus suspended the conductors are placed in a position of perfect security from interference in any manner whatever, and thereby insure an undisturbed and undiminished current. The electrical contact between the conductors and the motor on the car is had by means of the arm I, supported by the adjusting spring M, which sets in a case in the bottom frame of the car. The arm projects down through the slot into the conduit, and holds in place the contact wheels *J J*, which run in the concavity of the suspended conductors *G G*. The spring alluded to above, and the knuckle joint L, adjust and provide for the motion of the car, thus guaranteeing perfect and constant electrical contact without sparking. Both currents, outgoing and return, are provided for by the two conductors, and pass through the arm connection, which is so insulated that they are perfectly separated.



It will be noticed in this connection that one object and aim has been to thoroughly protect the electric current from interference in any manner, and for a perfect contact and connection between the conductors and the car motor. Electrical currents exposed to storms of snow, sleet or rain, lose largely by such exposure. In the Bidwell conduit system no interference of this kind can be had with the electrical conductors, suspended as they are under a projection, hence no loss of current is possible. The currents being below the surface are rendered harmless, as no direct contact can be had with them by surface traffic. Provisions are made for keeping the conduits clean by an arrangement of brushes connected with the car, sweeping the accumulations, which are slight, into the catch-basins provided therefor. In fact, every detail has been attended to and perfected by experience and covered by numerous letters patent.

The Bidwell Electric Railway & Manufacturing company, of Chicago, Ill., is prepared to contract for the construction and proper equipment of street railways by this conduit system.

A representative of the WESTERN ELECTRICIAN was a member of a party that tested the efficiency of this system on an experimental road at the foot of Madison street, Chicago. The car actuated by a motor, which in turn received the current from the conductors in the conduit, moved readily and easily at grade and just as easily mounted a grade of one foot in ten. At all times the car was under the most perfect control. It was started or stopped on the up and down grade instantaneously and without jar. The car can be heated and lighted by the current and the same conductors that transmit the electrical current to the car can be used to conduct it for lighting either streets or residences.

Telephone Siren.

At the last meeting of the Berlin Electrical society, Professor Karsten described his telephone siren. The instrument consists of a disc, to the face of which are fastened radially small steel bar magnets. This disc is revolved by clock work, and the pole of an ordinary Bell telephone, with diaphragm removed, is presented to the rim of the disc. The rapid passage of magnet poles induces currents in the telephone, and a musical note is produced in a telephone receiver connected with the siren. If all the magnets present the same polarity outwards, the number of complete waves produced during one revolution of the disc equals the number of magnets; if, however, the magnets are placed with alternating polarity, the number of complete waves is half that of the magnets, but the waves are stronger. In this case the tone heard in the receiver is the lower octave of the tone in the former case. It is also possible to arrange other combinations; for instance, if the poles are placed in the succession N N S, N N S, etc., the tone heard is the fifth of the former. Professor Karsten has found that this combination gives tones most readily distinguished by the human ear, and he recommends it where this apparatus is to be employed for the measurement of resistances by the use of a telephone instead of the galvanometer in bridge tests. He finds that the sound given by the siren is more easily distinguished from accidental noises which often accompany the employment of the usual make and break arrangement. By combining the siren with an anemometer it is possible to tell the strength of the wind from the tone produced in the receiver.

Electric Street Cars.

For several days experiments have been made on the Fourth avenue street railroad with a car propelled by an electric motor, says the New York *Tribune:* The car resembles in appearance an ordinary street-car with the horses removed, has a large unincumbered platform at each end, and can be run in either direction without being turned around. The energy to run the cars is obtained from Julien storage batteries, which are inserted from the outside through panels of the car and are placed under the seats. When in position they are not visible from any part of the car. Upon being pushed into place these batteries make automatic connection with the wires which lead from them to the motor. The two motors, of seven mechanical horse-power each, are placed on each axle of the car. They are small and occupy little space.

Under the Julien system only one motor is ordinarily placed on a car, but owing to the heavy grades in Madison avenue, some of which are 7 per cent., it was deemed advisable to place two motors on the car on which experiments were made. These motors are so arranged that they can be used separately or together. On level or ordinary grades one motor is said to be sufficient even with the heaviest load. The motor is controlled in its operation by a regulator which runs from the motor to either end of the car, and which is worked by a crank which the driver holds in his left hand. This crank is inserted into a small box in the shape of a dial with figures and letters on it, which indicate to the driver the rate of speed, how to start the car, and the like. The driver has only one crank to run the car with.

Beside the box is a switch which enables the driver to draw at will upon the energy stored in the batteries. The batteries are so arranged that the regulator can be used to draw from them in an instant, if necessary, as much energy as they would ordinarily expend in several minutes. This is done where a sharp curve is to be rounded or a start is to be made on a heavy grade, or in winter when the track is slippery. This is effected by the driver turning the switch at the side of his regulator which throws his batteries into series, thus giving him the highest electro-motive force attainable. This gives the mass to be moved an impact similar to that given by a cannon ball. When on the other hand a strong current is required in order to secure a high rate of speed, the driver, by turning his switch in an opposite direction from that above described, throws his batteries in parallel. In this way the two currents from each side of the car make, as it were, one stream of electrical energy of double the volume which prevailed when the batteries were in series.

All this is so simple that the most unskilled hand can safely be intrusted to run the car after receiving proper instructions. It is said that a car can be run by this motor at a cost of $4.10 a day, while the cost of running a car by horse-power is $7.50. The car experimented with ran along with an easy, steady motion and at times attained a speed of twelve miles an hour. It was stopped and started with less of the jar and jerk than the ordinary street-car. It was stopped on some of the sharpest curves and heaviest grades on the road and started again with ease.

Electric Light Stations in Paris.

Some large and comprehensive schemes for the extension of the existing central electric light stations at Paris, and the establishment of two new ones, have fallen through, the reason being a disagreement between the town council and the Edison company. Hitherto the fitting up of the electric light on the consumers' premises has been carried out by the Edison company; but the town council wanted to secure to consumers the right of having their installations fitted up by third parties, the electric light company to supervise and pass the work, for which they were to be paid at the rate of 10 per cent. on the cost, whilst the supervision for work done for the municipality would only be paid at 5 per cent. on the cost. To these innovations the Edison company would not agree, and the negotiations were thus brought to a close. The central stations under the management of the town will now be increased so as to furnish current for 40,000 glow lamps. Experience has shown that out of the total number of lamps fixed only two-thirds are ever lighted simultaneously, and therefore the enlarged stations will be able to serve a district containing 60,000 lamps.

An old lady, whose ideas of the electric current are a trifle vague, accosted a telegraph-pole climber, as he sunk his spurs into the wood. "Mister, are you goin' up?" "Yes." "Well, if there's a telegraph message from my son Johnny up there, just drop it down, will ye? I'm expectin' of him home."—*Golden Days.*

THE Electric club of New York has been incorporated.

Theory of Telephone Cables.

By W. R. Patterson.

Part I.

The factors which affect telephonic transmission over long lines, such as are necessarily used for ordinary commercial purposes, are so complex and are varied so by the continually changing conditions of line, instruments and users, that no simple formula will be found to give a general solution of the problem.

The formula that makes the speed of working vary as the total resistance times the total capacity of the circuit is not a general expression, but was calculated for and has been demonstrated by telegraphic work on ocean cables. The calculations of Dr. Wietlisbach on the transmission of vowel sounds and musical notes have not, as far as I am aware, been sufficiently demonstrated under the varying conditions of telephone circuits. Granting, however, the application of the formula to such transmission, the inference that general telephonic transmission is affected by these two factors only, is one that is not warranted by theory or experience.

In telegraphic work over ocean cables we have, comparatively, a very simple condition of affairs: A conductor of uniform conductivity and capacity and uniformly high insulation, surrounded by a uniform no-resistance ground and free from all outside disturbances; a method of transmission in which the only element to be considered is the fact that "time is money". If it is possible to transmit twenty words per minute there is no reason why we should desire to send forty, except that by this means we can double the income. If for any reason the conditions of the circuit are changed so as to prevent the transmission of forty, the line is not useless, but we go back to the twenty rate with no detriment to anything except the income.

But telephonically we have no control over the time factor; we can not avoid the difficulty by talking slower or altering the pitch except within very narrow limits. The number of vibrations per second is the fixed quantity; the line either works or it does not — there is no half-speed about it.

Given fixed conditions of circuit or of current and the necessary conditions of the other, to obtain a desired result are comparatively easy to determine. But given a circuit changeable in all its elements at the will of the central office operator and a current changeable with every word, tone or inflection of the speaker, and the equation is made up entirely of unknown quantities; and these are the conditions of telephonic transmission.

The telephone circuit is not a fixed quantity and has no factors which are fixed, either in their relative or absolute value. It is the combination of any two lines leading into a central office. It may be and generally is composed of part cable and part over-head line, the relative extent and position of which may change with every combination. The cable is not the simple uniform affair used in ocean telegraphy, but is a group of approximately parallel insulated conductors in closed in a common ground sheath. The instruments used can not be permanently adjusted to give the best results on circuits which are never alike and may vary from a few hundred feet to a hundred miles in length. The instruments may not be of the best and may not be in good order. The lines may not be in good condition and the users may not be experts. All these conditions of circuit and apparatus have to be met, with margin enough to work, except in case of very serious defects.

In the case of continuous musical sounds the current while different from a continuous current is at least symmetrical; the condition of things in the circuit is the same at any and all periods of time during which the current is vibrating at any given rate, and this is much more than the time during which it is changing from one to another. But it is the very want of uniformity, symmetry and continuity in the undulations of the current which is at once the cause and effect of telephonic transmission. We are not more interested in the transmission of a continuous *a* or *e* sound than in the transmission of that which enables us to distinguish between *e, c, g, d, t*. While the more time is occupied in the transmission of the vowel sounds, the transmission of the consonant sounds is what renders the conversation intelligible. In long distance telegraphy all obstacles in the way of the current tend to make the difference between the maximum and minimum points less abrupt and distinct, necessitating only a slower transmission and a more delicate adjustment of the receiving apparatus. In continuous musical sounds the only effect is a gradual weakening of the sound so that it is finally rendered inaudible. The *e* sound does not become an *a* sound or change its pitch; it simply fades out and we fail to hear it. But with the telephone we may lose the distinction between the *d* and *t* sounds while the *e* sound only loses volume. We can render a conversation unintelligible in three ways: By reducing the volume of sound till we fail to hear it all, while such faint sounds as we do hear may be perfectly distinct; by destroying the clearness of the sound, while not affecting its loudness; and by confusing the sounds with others from outside sources. It is true that this interference from outside currents may destroy the efficiency of any electric transmission. But a telephonic current is the most easily affected and may be entirely overcome by currents which would at most require but a change in adjustment in other cases. No increased loudness will compensate for lack of distinctness and no distinctness will compensate for loss of volume except within narrow limits.

I do not claim it is established beyond all question, but from observation I am led to think that it is a good working hypothesis that resistance affects principally the loudness, and capacity the distinctness of the sounds, and that one is not in its effects an equivalent of the other. To make the matter plainer, I will tabulate and classify the principal obstacles to telephonic work, placing in vertical columns under the heads of "loudness" and "clearness" those factors which I think have predominating effects in those directions; and arranging in three classes those which (1) are unavoidable; which (2) should be reduced to a minimum, and (3), those which can and should be entirely removed, but which we know often exist:

	LOUDNESS.	CLEARNESS.
Unavoidable and must be taken into account in every case.	Kind of Apparatus used. Personal Equation. Resistance of conductor.	Capacity, Self-induction, Secondary Induction Induced Currents, from other Circuits.
Sometimes present. Should be reduced to a minimum.	Faults of Operators. Escape from	Escape to Electro-magnets and iron wire in circuit.
Removable and should never be found except temporarily from accident.	Faults of Apparatus. Resistance of joints and grounds.	Common Grounds. Extraneous Noises.

In discussing these factors we can dismiss the third and second classes briefly. Where possible they should be removed, and, if unavoidable, should be reduced to a minimum. That any one or all of these factors often exist is a fact too well known to need argument. It is possible to get a circuit free from all for a laboratory experiment, but in practice we must have sufficient margin to give satisfactory service with considerable disturbance from one or all. With reference to the effect of escape from and to the circuit, Dr. Wietlisbach says his formula requires the insulation to be perfect—at least 1,000 megohms per kilometer. In circuits composed of aerial cables, this insulation can never be secured in hot weather, and if there are pole lines in the circuit it can not be secured in wet weather.

An insulation of 1,000 megohms per kilometer, or, say, 1,600 per mile throughout can never be maintained in the combination circuits in use in our large cities; and the question of escape, outside its effect upon the capacity factor, is always a serious one, however high may be the mileage insulation of the cable.

I will not stop to discuss the question of what is the best insulation resistance to obtain the best telephonic results, except to say that if we had an unchanging insulating substance of low specific resistance so that low insulation in a cable would not invariably mean a defect of workmanship or material, a great part of our difficulty would be overcome. High insulation is, telephonically, a necessary evil. In class (1) there is no doubt that resistance and capacity are the principal factors, but it is not probable that the factor of self-induction could be ignored as is usually assumed. Where the current is continually changing and its duration with any uniformity is so short compared with the time when it is changing the effect of self-induction must be appreciable. It is only when the current is changing that it would be felt, but this current is made of continuous changes.

Casualties by Lightning.

At Mt. Pleasant, sixty miles from Nashville, Tenn., on the 12th inst., nine colored persons who were mourners at a funeral, sought shelter under a huge oak tree from a thunder shower. Lightning struck the tree and killed the nine.

At Cardsville, Ky., July 12th, three men were caught in a thunder shower while driving. They stopped to adjust the harness, when lightning struck and instantly killed two of them.

At Opelika, Ala., July 12th, a family stood on a veranda watching the brilliant electric display of a storm. They were struck by lightning, two children were instantly killed and the mother and another child so paralyzed that it was thought they would not recover.

Near Columbia, S. C., July 15th, while a family was at dinner the house was struck by lightning. The father and one child were instantly killed and the mother and three other children so shocked that it was thought they would not survive.

At Middleton, N. Y., July 15th, a boy while working in a hay field, was struck by lightning. The charge made a hole through the crown of the lads 'straw hat, and then divided, passing down to the earth on either side, ripping open one leg of his trousers, and on the other side tearing the shoe from his foot. He was unconscious for about an hour, but next morning had almost entirely recovered.

At Palestine, Tex., July 8th, a gentleman and lady sought shelter during a storm under a large tree. After the storm subsided they were found dead from a stroke of lightning. The charge had struck the man on the back of the head and stripped the clothing and flesh to the heels. The lady was burned from the breast the full length of the body down to the feet. Both bodies were blackened and disfigured.

At Mount Olivet, near Lebanon, Tenn., July 14th, lightning struck a church and knocked senseless every one of the hundred worshipers present.

At Reading, Penn., a man was killed by lightning July 18th.

Six campers at Grand Pond, six miles from Scranton, July 18th, were badly burned by lightning, which struck their tent.

Says "Carp" the Cleveland *Leader* correspondent: "The electric light is, by the way, much more extensively used in the west than in the east. I have not stopped at one hotel, save at Findlay, where natural gas is used, that I have not found its office, parlors and bed rooms lighted by electricity. The wire loop Edison burner is most common, and I understand it is largely in private use in the smaller towns.

Electrical Problems.

In Fig. 1, *a*, *b*, *c*, and *d* are condensers. *E* is a battery. The battery has an E. M. F. of 100 volts. For convenience we will say that the condenser *a* has a capacity of two farads, and *b*, *c*, *d* have ten farads each, as marked. The connecting wires have practically no resistance. *R* is a resistance of 100 ohms, which limits the rate of flow or volume of current when charging and discharging to one ampère over the connecting wire between condensers *b* and *c*.

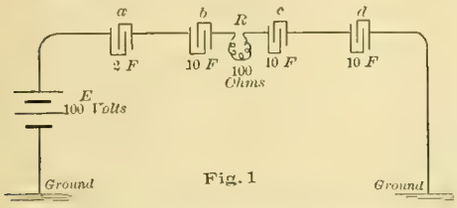


Fig. 1

Queries: 1. Will condensers *b*, *c*, and *d* contain the same charge as *a*, when *a* is fully charged?

2. Will the potentials then be the same in all? If not, what is the potential on each one?

3. Will the rate of flow when charging and discharging be the same over each connecting wire in the series that it is between *b* and *c*?

4. Will all the condensers become charged at the same time?

5. Will the current have the same volume and the same E. M. F. over each connecting wire?

6. Will it be so if *R* is removed?

7. Is this formula correct for the capacity of this series:

$$C = \frac{1}{\frac{1}{2}+\frac{1}{10}+\frac{1}{10}+\frac{1}{10}} = \frac{10}{8}\ F?$$

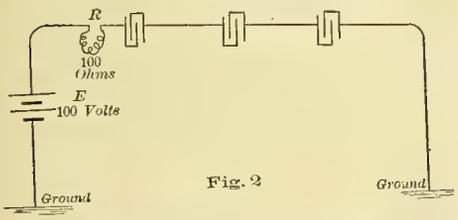


Fig. 2

1 Will inserting this resistance (see Fig. 2) between the battery and the first condenser reduce the potential of the charge when the condenser is fully charged?

2. Or will the potential be the same as if the *R* had not been there?

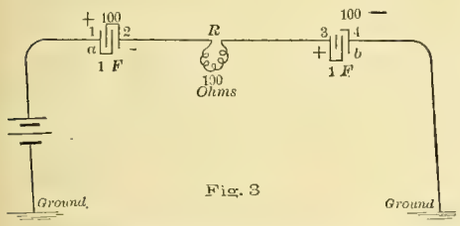


Fig. 3

The capacity of *a* and *b*, in Fig 3, is one farad each. The E. M. F. of the battery is 100 volts. The potential is therefore 100, as marked. While charging and discharging, a current passes over the connecting wires. It can not flow from *1* to *2*, or *3* to *4*, but it can and does from *2* to *3*.

1. Is the rate of flow between *a* and *b* governed by the difference of potential (+100,

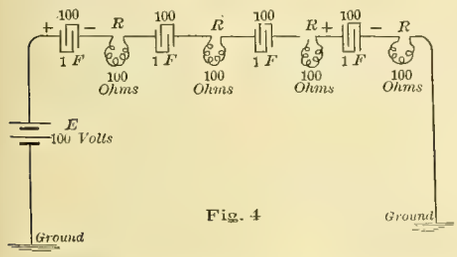


Fig. 4

—100=200), or by the E. M. F. of the battery, 100? In the former case the current is two ampères; in the latter, one ampère.

2. Is the current that flows driven between *a* and *b* by electric attraction and repulsion at the condensers, or does it flow in consequence of the difference of potential between *1* and *4*, as in ordinary circuits.

3. Has the current that flows the E. M. F. of the battery, or that due to the difference of potential in the condensers? i. e., is it a 100 volt or a 200 volt current?

1. Referring to Fig. 4, is the rate of flow one ampère or two ampères?

2. Does the battery overcome the total resistance of 400 ohms?

3. Or, does it simply charge the first condenser, the current then overcoming the 100 ohms by virtue of the difference of potential

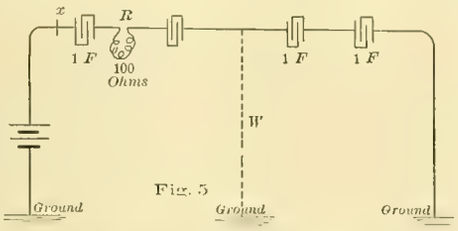


Fig. 5

thereby established, thus charging the second condenser, which sends a current through the next 100 ohms, and so on, repeating this action through the series?

4. If the resistance between the first and second condensers was made 200 ohms, would the rate of flow through the series be governed by:

$$\frac{\text{difference of potential}}{\text{highest } R \text{ in any section}} = \frac{200}{200} = 1 \text{ ampère?}$$

$$\text{or, } \frac{200}{500} = \frac{2}{5} \text{ ampère?}$$

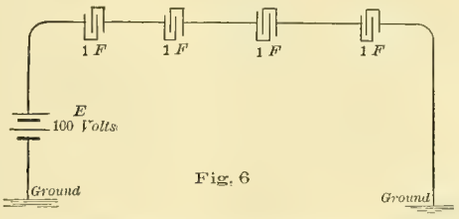


Fig. 6

The capacity of the series of four condensers in Fig. 5 is one-quarter farad. It charges up (100 V. through 100 O.) in one second, say. If the series is then discharged and connected to earth by wire *W*, its capacity will be one-half farad. Now connect it to the battery. At the end of one second break the battery circuit at *x*.

1. Is the potential of the charge now the same as before?

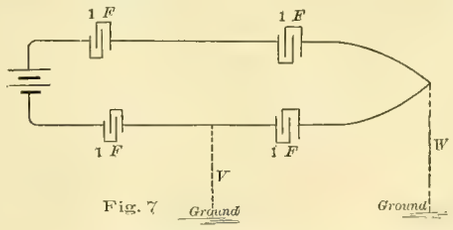


Fig. 7

2. Or is it one-half as high as the full series was (one-half charged)?

3. If the potential is half as high as before, is the rate of flow through *R* further reduced one-half thereby?

4. Or is the rate of flow always governed by the E. M. F. of the battery: $C = \frac{E}{R}$

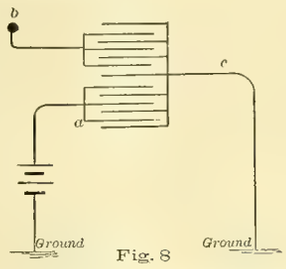


Fig. 8

1. Does this series (see Fig. 6) charge up in a quarter the time that one condenser alone would charge in?

2. Or does it take the same time?

3. In the former case, the condensers all charge up simultaneously; in the latter, successively?

1. Is the capacity of this series (see Fig. 7) (without any ground wires at *W* or *V*) one-quarter farad or one-half farad?

2. If connection is now made to earth at *W*, will any current flow through *W* when charging and discharging?

3. If *W* is removed, and connected at *V*, will any current flow through *V* when charging and discharging the series of 4?

The condenser plates *c* in Fig. 8 are all connected on one side; on the other side, plates *a* are connected to the battery, but plates *b* are not; the connecting wire is well insulated, as shown.

Would the current through the wire *c*, when charging and discharging, be the same as if plates *b* were not there, or the upper one-half of condenser was gone?

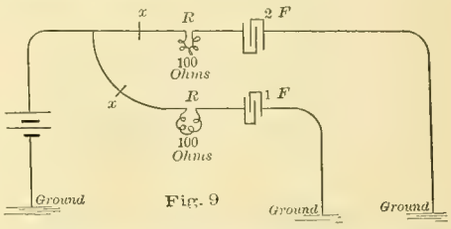


Fig. 9

In Fig. 9, battery is connected; then circuits broken at *x*, *x*, as soon as the 1 *F* condenser is charged, the 2 *F* condenser is therefore one-half charged.

1. Will both condensers have the same potential?

2. Or will the 2 *F* condenser have one-half potential of 1 *F* condenser?

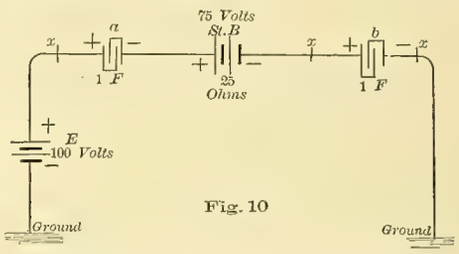


Fig. 10

In Fig. 10, *St. B.* is an E. M. F. which we can oppose to *E*. We will suppose that *St. B.* is a storage battery arranged as shown, with poles opposed to those of battery *E*; that the current sent by *E* through *St. B.* is 25 volts; that at the end of one second the charging of condenser *b* is completed; and at that instant we break the circuits of both condensers at *x*, *x*, *x*, *x*, and leave the condenser plates in their then conditions.

What are the potentials on both sides of the condensers?

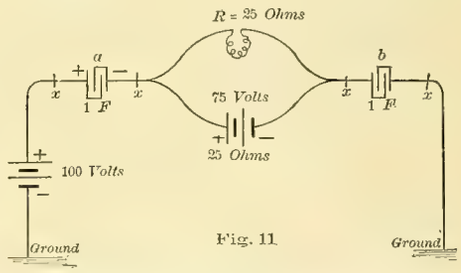


Fig. 11

The conditions in Fig. 11 are the same as in sketch above, except that there is a shunt around *St. B.*, with 25 ohms resistance inserted equal to that of *St. B.* Supposing that condenser *b* is charged in one second, and circuits opened at *x*, *x*, *x*, *x*, as before —

What are the potentials at that instant on both sides of the condenser?

"The electric railroads in Los Angeles, Cal, where the climate is considered to be the most suitable for them, are decided failures. One electric road, about one and a half miles in length, requires an engine of about fifty horse-power to supply the electricity of two cars, and, at this rate, is considered not profitable." So reads a stray clipping that has found its way to this office. There must be something decidedly wrong in the administration of this plant. With the meager data given, it is not possible to indicate the location of the defect, but the fact cannot be controverted that electric railroads can show many points of economy.

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Carbon Combination Broken.

The chief topic of conversation of the week among electric light men has been the breaking of the carbon combination—a result distinctly foreshadowed in a special dispatch from Cleveland, published exclusively in the columns of the WESTERN ELECTRICIAN last week. Just after the telegram had been given publicity notifications were sent out from Cleveland to the effect that the combination had gone to pieces, and that carbons were to be bought at the old price of $12 a thousand.

The maintenance of a combination of manufacturers bound to observe a fixed pool price on any article or class of articles is exceedingly difficult under any circumstances, and it has been common opinion among well-posted buyers of carbons that it was only a question of time—and a short time—when the combination would go to pieces. Unquestionably one chief element in the breaking of the combination was the largely increased amounts to which prices were advanced just after the formation of the combination. Carbons had been selling at $10 to $12 a thousand, but when the combination was formed prices were jumped to $20 and $25 a thousand. One keen buyer said to an editor of the WESTERN ELECTRICIAN some time ago that he should not have objected to a price of, say, $12 and $15 a thousand, but that the prices demanded by the combination were exorbitant and he proposed to protect himself as far as possible. It matters little which member of the combination was the first to relapse. With a counter-combination of electric light men to make their own carbons and with one of the largest consumers of carbons in the country establishing an independent plant for the manufacture of the points, combination prices could not have been maintained for any length of time. It is said that the ruling prices of today are too low; that they have no margin for profit. If that is the case, it is to be regretted, for capital, labor and the quality of products must suffer, while cheaper methods of manufacture are being devised.

THE Belt Railroad company of New York City lately put seven hundred green horses to work on its line, and before they got hardened to the work the heat had killed three hundred of them. On Saturday, the 16th, the heat reached 99 degrees in New York, and many a poor street car horse was hitched up for the last time on that day. The fearful mortality among their horses has aroused the New York belt line people to the necessity of employing other than animal power, and they will investigate electricity. The universal employment of the electric motor is demanded on street railroads, not only because it is cheaper and more satisfactory in every way, but from the humane standpoint as well. The suffering among the street car horses in New York last Saturday was something terrible. Then, too, it cuts quite a figure when the cost of 300 new horses has to be added to the operating expense account.

THE American Institute of Electrical Exhibition which will be held in New York, commencing September 28th and closing December 3rd next, is in good hands judging from a list of the committees having it in charge. The exhibition will undoubtedly be of great interest and value both to participants and visitors. The efforts of the society should meet hearty coöperation and unquestionably will.

THE list of questions on the charge of the condenser and its relations to the E. M. F. of the battery published this week is given place for the purpose of eliciting comment and discussion. While some of the questions are very easily answered, others demand the most careful scrutiny and a discussion of the principles involved, can not fail to be highly profitable and interesting.

THE long list of casualties by lightning, found in another column, shows the importance of proper protection to buildings, especially to churches and other buildings having spires or cupolas, and of proper precaution during thunder storms where protection is not possible. In two of the instances given, it will be noticed the parties sought shelter under trees. This is very dangerous, especially if the trees are tall and somewhat isolated, though evergreens probably afford protection by their numerous sharp-pointed leaves, which can not be found under deciduous trees which furnish better shelter from rain. But the great importance of protecting buildings by conductors constructed and erected on true scientific principles can not be too strongly enforced; nor can the cheap, worthless shams and humbugs, dignified as lightning rods, of which the country is full, be too strongly condemned.

We desire especially that in every instance of a building being struck by lightning our readers would ascertain whether it had a rod, and if so, of what material it was made, and whether insulated from the building or connected with it electrically, and especially with the gutters and rain-water pipes; and what was the nature of its ground connection and air terminals, and of its joints, if not continuous. This will enable us to direct attention to the various defects and to point out the true scientific principles both of construction and erection.

LAST week the twenty-seventh annual convention of the National Educational Association was held in this city, bringing together over 12,000 teachers of every grade, from the university, the college, the high school, the grammar school, and primary school.

Among the various subjects discussed, all reference to electric science, either incidentally or otherwise, was conspicuously absent. The tendency among educators seems to be in favor of curtailing rather than extending the range of study in all our educational institutions. Perhaps this is wise, in view of the already extended range, and the limited time for thorough work. And yet, in view of the immense advance in electric science and its applications within the last twenty years, it can not be denied that there is abundant room for improvement in the methods by which its principles are taught in most of our high schools and colleges. These facts show the importance of polytechnic schools, of special departments in our colleges and universities for instruction in electricity and electric engineering, similar to that in Cornell University, and of free lecture courses in all our principal towns and cities, where the mechanic engaged in electric work can obtain at least a general knowledge of the principles of electricity and their applications.

Let the men whose wealth is derived from the telegraph, the telephone, and the electric light come forward and endow such lecture courses, and furnish the buildings, the laboratories, the apparatus and the lecturers, so that the mechanics in their employ can receive evening instruction.

There is great demand to-day for just such an established lecture course in Chicago. Who will start the endowment fund?

How to Make an Electrophorus.

The electrophorus or bearer of electricity, as the name implies, invented by Volta in 1775, is one of the most useful instruments in the electrician's laboratory; often supplying the place of the more expensive electric machine, and better adapted to that class of delicate experiments in static electricity which require a light electric charge. The mode of action of the instrument is also, in itself, a highly interesting study, affording opportunity for observing electric phenomena of a very peculiar character.

The methods of making this instrument, as given in most of the text-books, are too antiquated for present use, and were evidently written before the invention of hard-rubber and its advantages in the manufacture of electric instruments became generally known. Its construction is very simple; the parts consisting of a plate of any suitable dielectric, mounted on a base, and having a metal cover above it and a metal lining underneath. The dielectrics usually prescribed in the text-books are sealing-wax, parafin, mixtures of bees-wax and resin, or of shellac, resin, and Venice turpentine. All these are troublesome to prepare, requiring to be melted, and moulded into proper shape; and are lacking in the important qualities of neatness, durability and efficiency; the necessary thickness required for strength reducing the inductive qualities derived from thinness, which are so important in a dielectric, especially for this instrument whose chief value results from induction.

The use of a hard-rubber plate for the dielectric obviates all these difficulties; it is easily obtained at comparatively small cost, has all the requisites of strength, neatness, and efficiency, and can be cut, bored and fitted as required. A plate thirteen inches square and 1-16 of an inch in thickness gives all the efficiency required, and makes the instrument more convenient than a larger size, which would require a heavy cover, hard to make, and cumbersome to handle. There is also a special advantage in having this plate square, so that the cover may be insulated and out of contact with attaching screws.

The base may be of wood or metal as preferred; if of wood, special precautions must be used to prevent warping, by using cleats underneath, molding round the edges, or a laminated board, made of three layers glued together, the grain of the central layer at right angles to that of the other two. Drawer knobs may be used for feet. The base must be the same size as the rubber plate, and the plate be attached to it by a screw at each corner; allowance being made for expansion and contraction of the rubber by enlarged screw holes and a loose contact. Under this plate is placed the metal lining, which may be of tin-foil, tin-plate, or light sheet brass; and a strip of the metal half an inch wide should pass over the edge of the base near the center of one side, and be attached underneath, for contact in using the instrument. If a metal base is used, it may be of brass, iron, or other good conductor, and the metal lining and contact strip, can be dispensed with.

For the cover a circular plate of No. 20 sheet brass, 12 inches in diameter, made perfectly flat under a planishing hammer, is required. To its center is screwed a vertical handle, of hard rubber, 7 inches high, and ¾ of an inch in diameter; and to its circumference, on the upper surface, is soldered a rim of half round brass rod. From this rim projects a goose-neck of No. 8 brass rod terminating in a half inch brass ball.

If a cheaper style is desired the cover may be of tin, and the rim of iron wire inclosed in the usual manner. If the instrument is made in this way a ten inch cover is preferable, the base and other parts being reduced in the same proportion.

Electricity as a Mode of Motion.

By Philip Atkinson, Ph. D.

PART II.

In the thermopile we have electricity generated by the direct agency of heat, and in order to create a difference of electric potential, which is the principle upon which every electric generator is based, a difference of heat potential must be created. This is accomplished by the use of two metals, usually bismuth and antimony, having different conductivities for heat and electricity. Bars of each are smelted together at the ends, and arranged in compact form in an alternating series, in such a manner that one set of junctions can be heated while the alternate opposite set is cooled. The electric current flows across each heated junction from bismuth to antimony, and across each cooled junction from antimony to bismuth, so that at each junction it receives a fresh impulse in the same general direction, since the heated and cooled junctions alternate. The capacity of bismuth for heat, known as its specific heat, is 0.036, and that of antimony 0.051, water being unity, and the temperature of each when heated or cooled from the same source varies in the inverse ratio of its specific heat; hence, at the heated junctions the temperature of the bismuth rises above that of the antimony, and at the cooled junctions falls below it; and as the heat movement as well as the electric movement is from higher to lower potential, we find here an exact correspondence in the movement of each.

But there is also a difference in the molecular constitution of the two metals, as indicated by their crystalline structure, bismuth crystallizing in one form while antimony crystallizes in another; and the greater the difference in this respect, as well as in conductivity for heat and electricity, between these or any other two metals, the more energetic the electric action. Indeed this difference in crystalline structure, and hence in molecular constitution, is undoubtedly the cause of the difference in conductivity; the difference in electric and heat potentials corresponding, as shown, to the difference in conductivity and molecular structure.

But we have also in this instrument an instance of the reciprocal action between heat and electricity. If instead of heating and cooling alternate junctions to generate electricity an electric current is passed through from an external source, the junctions become heated or cooled according to the direction of the current. A current passed through a bismuth-antimony pair from antimony to bismuth heats the junction, while if passed through from bismuth to antimony the junction is cooled. According to the doctrine that heat is a mode of motion, the heating is an increase in the intensity of motion, and the cooling a decrease of that intensity; and in this experiment the reduction of temperature has been carried to such an extent that water has been frozen in cavities made in the metals. It will also be perceived that the same correspondence of movement between heat and electricity exists in the reciprocal action by which heat is generated, as in the direct action by which electricity is generated.

The generation of electricity by light, or as Dr. Werner Siemens terms it, "the direct conversion of the energy of light into electric energy," has received the attention of leading electricians, and led to the invention of instruments for that purpose; and although the invention is still confined to the laboratory, enough is known to demonstrate the possibility of such conversion, and hence to establish the fact of such an intimate relation between these two different manifestations of energy as to indicate the probability of a similar nature. The means employed is, in some respects, not unlike that already described for the generation of electricity by heat—a combination of metals differing in molecular construction and conductivity. But in this case metal plates are used, and selenium seems to have the preference, combined with gold and some base metal.

The accepted doctrine of light as a mode of motion is too well-known to require elucidation here, but the nature of the instrument above referred to, and the requisite of metals for its construction differing in molecular constitution indicate that the mode of motion known as light is changed by contact with the metals into the mode of motion known as electricity, either by this contact generating the resulting mode of motion in the metals themselves, or in some medium permeating their structure.

The action then in all these modes of generation is both direct and reciprocal. Heat produces electricity and electricity produces heat; magnetism produces electricity and electricity produces magnetism; light produces electricity and electricity produces light. There is also reciprocal action between mechanical motion and electricity, but the connection is not so close and intimate as between the different forms of molecular motion, in which proof in regard to the nature of one, becomes proof in regard to the nature of the other.

Thus far we have confined our attention to electric generation, but electrical transmission is of equal importance in elucidating our subject; for if we could satisfactorily determine how electricity is transmitted, we should be in a fair way to determine what it is.

Assuming the truth of our original proposition, that energy is inseparable from matter, and that electricity is one of the forms in which energy manifests itself, a medium consisting of matter in some form is essential to its transmission. On this point there are two theories, one that energy uses the different forms of tangible matter as its medium, the other that all tangible matter, solid, liquid and gaseous is permeated by a certain intangible fluid known as ether, which constitutes the medium for electric transmission. The former theory assumes that electric transmission is by vibrations of the tangible matter itself; the latter, that it is by vibrations of the intangible ether. As both theories assume a mode of motion, and are in this respect equally well adapted to our purpose, it is unnecessary to enter into the discussion of their respective merits, further than to say, that the existence of ether has never been demonstrated, that the ether theory is unsupported except by inferential proof, and that the transmission of electric energy by the vibratory motion of tangible matter is the more reasonable theory of the two, and far more susceptible of demonstration.

The theory of the universal ether was originally invented to meet the necessity of a medium for the transmission of light through the interplanetary spaces, where it has been supposed that air can not exist, and its adaptation to electricity is of more recent origin. But the theory of the existence of a universal atmosphere, like that of the earth, has strong support; though in the interplanetary spaces it must be almost as impalable as the supposed ether itself.

The two important factors in electric transmission are conductivity and resistance, one of which is always in the inverse ratio of the other, and the relative proportions of each in every substance constitute the difference between the conductor and the non-conductor.

We may assume that electric transmission depends on molecular structure, that in good conductors this structure is such as to facilitate transmission, and in inferior conductors to retard it, while the structure of non-conductors is such as almost wholly to prevent it: and we may suppose, that in a good conductor the molecules lie in parallel lines, and that the electric energy causes each molecule to impinge on the next contiguous one, producing a trill or wave which runs through the conductor for perhaps 1,000 miles in an instant; but that in the inferior conductor, or the non-conductor, the molecular arrangement is more or less irregular, requiring a wrenching or twisting of the molecules to bring them into position. It is evident, that in the latter case far greater energy is required to produce the same result, and that this series of wrenchings and twistings must result in the co-incidental development of that other mode of motion which we term heat. So that while in a good conductor, as a copper wire, electric transmission is easily effected, and the development of heat very slight, in an inferior conductor, as a platinum wire, or a carbon filament, the heat development rises to incandescence. These results indicate that the transmission of electric energy is by molecular motion as assumed, or rather that this mode of motion, by which this energy manifests itself is that which we term electricity.

According to the old theory of thunder and lightning, the passage of electric fluid through the air produces the flash, and the thunder is a result of the air displacement and collapse. This theory is evidently incompatible with the theory of electric energy using the air as its medium. According to the latter view there is no passage of electric matter through the air, and consequently no displacement except that resulting from the incidental development of heat. The electric discharge takes place along a narrow line, often three to five miles or more in length. The air along this line becomes incandescent, and is expanded by the intense heat, but the partial vacuum thus created is confined to this narrow line, and the collapse is quite insufficient to account for the terrific peal of thunder which often accompanies the flash. Put the intense vibration occurring throughout this long line in an infinitesimal moment of time must produce the thunder-peal in strict accordance with the well known laws of sound. It is possible that the succession of vibrations following the discharge, and set in motion by it, produces the rumble often heard, but the one tremendous vibration is the first immediate result of the discharge.

Comparing the results of thunder and lightning with those of explosions of gunpowder and dynamite, we find a very essential difference. In the explosion there is a displacement of a great volume of air, not confined to a single line, but diffused over a large space; and the results of the sudden expansion and collapse are often the breaking of glass and the destruction of building in the immediate vicinity, the effect of the air movement being often felt at a distance too great for the sound to be audible. But the electric discharge takes place over our dwellings, or between earth and cloud in our immediate vicinity, accompanied by the terrific thunder-peal, often far exceeding the sound of the loudest explosion, and the only perceptible effect is a slight tremor such as should follow from the vibratory movement assumed in our hypothesis. Hence we conclude that the transmission of electric energy in this case is by a vibratory motion; or, as before, that this mode of motion, so produced, is electricity.

All electric action is an exhibition of energy, whether it be in the movement of a pith ball, in the flash of the electric spark, in the brilliancy of the arc light or the softer radiance of the incandescent, in the deposition of metal by electrolysis, the click of the telegraph, the speech-producing movement in the telephone, the propelling of cars on a railway, or in the lightning's flash rending the oak. It produces chemical decomposition, mechanical motion, light and heat. It inflicts pain, destroys life, soothes suffering, heals disease. All these varied phenomena are different manifestations of energy.

Since electricity then is a product of energy and a producer of energy, it is manifestly closely allied to energy. But high electric authority says "Whatever electricity is it is not energy." This is true if we speak of energy in the abstract. But in this sense neither is heat energy, nor light, gravity, or mechanical motion. Energy in the abstract is a mere mental conception having no actual existence; it must act through matter as its medium, and in this concrete sense there can be no more objection to regarding electricity as one of the forms in which energy manifests itself than in regarding heat, light or sound in that sense; and since every manifestation of energy is by means of motion, the conclusion seems inevitable that electricity is a mode of motion.

England's Telegraph System.

Mr. Raikes, the postmaster-general, stated in the house of commons recently that the number of telegrams sent for some weeks past exceeded a million per week, whereas under the shilling system only 700,000 to 800,000 were sent in the same space of time. It was still, he said, impossible to say whether the sixpenny system paid its way or not, since the increased expenditure had been considerable. During the next year the revenue, it was hoped, would be largely increased, while the expenditure would be reduced. The new system was yet in its infancy, and the outlook for the future appeared to him to be hopeful.—*London Queen.*

Hudson, N.Y., will introduce electric lights.

Ries' Electric Railway Brake.

Elias E. Ries, of Baltimore, claims to have invented an efficient method of applying or graduating the flow of the electric current to the brake apparatus of a train or car, so as to prevent the sudden application and shock that has hitherto been unavoidable in all electric brake appliances. Efforts have been made by many, from time to time, to utilize electricity for operating railway friction brakes, as its acknowledged superiority, from a practical and economical point of view, peculiarly adapts it for this class of work. These attempts have, however, in many cases been unsuccessful, mainly because of the sudden strain and concussion upon the moving portions of the brake mechanism and wheels, and the great abruptness and severity with which the brakes were applied when the circuit leading to the brake device was closed. In other words, that most important quality of the current so valuable in this and in other applications of electricity—its great speed and rapidity of action—proved most detrimental in the present instance, simply because it prevented that easy and gradual control of the current essential to success. Great difficulty was also experienced in properly regulating the amount of braking force exerted by the devices heretofore employed, and for varying this amount to suit the different requirements met with in practical work.

The Ries' system, it is claimed, overcomes these difficulties in a very simple and effective manner by the employment in the brake circuit of an automatic circuit-closing device provided with two independent levers. One of these levers is under the control of the engineer, and determines the extent to which the brakes shall be applied, while the other is automatic in its action; and when the first-mentioned lever is moved, operates to transmit and gradually increase the flow of current to the electro-magnetic brake devices, until they have reached the strength determined by the position of the first-named lever. By this means the brake devices are not only protected from sudden strain, but when the speed of the transmitting lever is once properly adjusted, the brakes can be applied and the train brought to a standstill within the shortest possible space of time.

Figure I is a sectional elevation of the inclosing-case of the regulating and governing apparatus, giving a general view of the interior and showing the connections when it is intended to be used to regulate the current from a primary or a secondary battery. Fig. II is a sectional end elevation of the same with the cover and switch-lever in place. Fig. III is a view similar to Fig. I, except that this view shows the interior connections when it is intended to regulate the current transmitted to a derived working-circuit from a main working-circuit, or to transmit the direct current from a suitable generator to one or more translating devices that require a gradual application of the current. Fig. IV is a detail sectional view of the automatic regulating and governing devices. Fig. V is a front elevation of the apparatus, showing the switch-lever and the arrangement of circuits when used in connection with the cells of a secondary battery. Fig. VI is a diagram view of a secondary battery, illustrating the method in which the cells are connected to the binding-posts leading to the upper row of contacts of the apparatus. Fig. 7 is an enlarged sectional view of the dash-pot piston and its openings.

Referring to the letters of reference, *A* is an inclosing-case containing the circuit-closing mechanism. This case is provided with a cover or door, *a*, and may either be made of cast-iron, or, if desired, of insulating material—such, for instance, as hard rubber. A shaft, *B*, is supported in insulated bearings *b b*, fixed in the front and back of the case, respectively, and loosely mounted on this shaft is a contact-lever, *C*, having contact-surfaces *c c'*, one at each extremity of the lever. These contact-surfaces are adapted to make electrical contact with two independent series of contacts, *d d'*, placed, respectively, in the paths of the contact-surfaces *c* and *c'*. The contacts *d d'* are secured to a plate, *D*, of insulating material, or are fixed directly to the rear wall of the inclosing case, if the latter is formed of non-conducting material, as before stated. The upper series of contacts connect, respectively, with a corresponding number of binding-posts, b^1 b^2 b^3, etc., arranged along the curved top of the case *A*, and these in turn are connected with a secondary battery.

Suitably secured to the interior of the case *A* is a curved solenoid or helix, *F*, whose soft-iron core *f* is firmly fixed to the contact-lever *C* at or near its lower extremity, and is curved to correspond with the shape of the interior of the solenoid, as shown in the sectional view, Fig. IV. Directly opposite the solenoid is a dash-pot, *G*, whose function is to regulate the motion and prevent the too rapid entrance of the core *f* into the solenoid when the latter is energized. To this end the dash-pot is provided with a piston, *g*, having two valves or openings therein of different size and opening in opposite directions, as shown at g^2 and g^3, Fig. 7. The interior of the dash-pot cylinder is filled with a suitable liquid—such as glycerine—and when the piston *g* is drawn out by the action of the solenoid, the liquid escapes through the smaller opening, g^2, into the rear of the cylinder. The opening in this valve can be regulated by an adjustable tapering set-screw, as shown, and as the space of time in which the solenoid can draw the piston to the other end of the dash-pot is determined by the size of the opening in the piston, and consequently by the length of time required by the liquid to pass from one side of the piston to the other, it will be seen that the motion of the lever *C* over the series of contacts *d* and *d'* is not only very regular, but the time occupied by it in doing so can be accurately adjusted by regulating the size of the opening in the piston. When the current passing through the solenoid is interrupted, the contact-lever and the various parts connected therewith are restored to their normal position, as shown in Figs. I and III, by the action of the spiral spring *H*, the liquid in the dash-pot in this case passing through the larger valve.

Although the dash-pot cylinder is shown curved, in order to better harmonize with the form of the inclosing-case, it is clear that any other form of cylinder may be used, or other substitute—such as air—employed therein without departing from the spirit of this feature of the invention.

Near the front end of the shaft *B* is pivoted a switch-lever, *I*, having a handle, *J*, of non-conducting material, and a sector-pawl or ratchet-lever, *K*, designed to enter notches *k*, placed at intervals along the arc formed by the top of the case *A*. A projecting arm, *i*, extends backward from the lever *I*, and, being in the path of a similar projection, i^2, on the contact-lever *C*, (see Fig. II,) serves to limit the forward motion of the latter in such a manner that when acted upon by the solenoid it can not move over a greater number of contacts than those determined by the position of the handle *J*. The contact-lever *C* is in electrical connection with the switch-lever *I* through the shaft *B*.

Referring to Figs. V and VI, it will be seen that the cells of the secondary battery, represented by the figures 1 2 3 4 5 6 7 8 and 9, and which are connected in series with each other, are consecutively connected with the binding-posts b^1 b^2 b^3, etc., the wire from the + pole of the first cell being connected with the binding-post *L* and *l* at the left of the apparatus and being continued from the latter to the translating devices, the current to which it is desired to regulate. The wire from the other side of the translating devices is brought back to the binding-posts *l'* and *L'*, the latter connecting with a segment or curved contact-plate, *M*, with which the switch-lever *I* makes connection when it is moved to the right of the instrument from a similar but smaller contact-plate, *m*, at the left, and upon which the lever *I* rests when the circuit through the instrument is open. The solenoid *F* in the present instance is connected with the binding-posts *l* and *l'*, as shown in Fig. I, and is therefore in multiple arc with the circuit-wires.

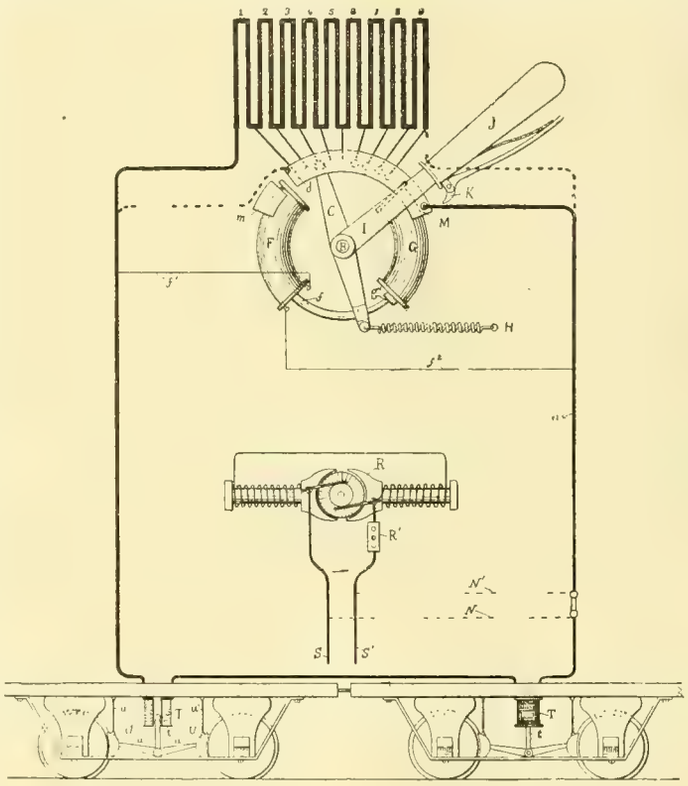


Fig. 8.

A series of storage batteries, shown in heavy black lines in Fig. 8, are connected to the brake magnets near the wheels. The batteries are connected to a switch, so that a contact passing over them puts a successively increasing number of cells on the circuit. The cylindrical quadrant shown at the left is a solenoid which is connected in shunt with the battery circuit. Its core is prolonged and extends into a dash-pot or regulating cylinder, whose function is to regulate the motion and prevent the too rapid entrance of the core into the solenoid when the latter is energized. A spiral spring serves to return the contact-lever together with the core and piston-rod, which are firmly secured to the contact-lever, to their normal position, so that the lever will rest upon the first contact to the left when no current is passing through the solenoid.

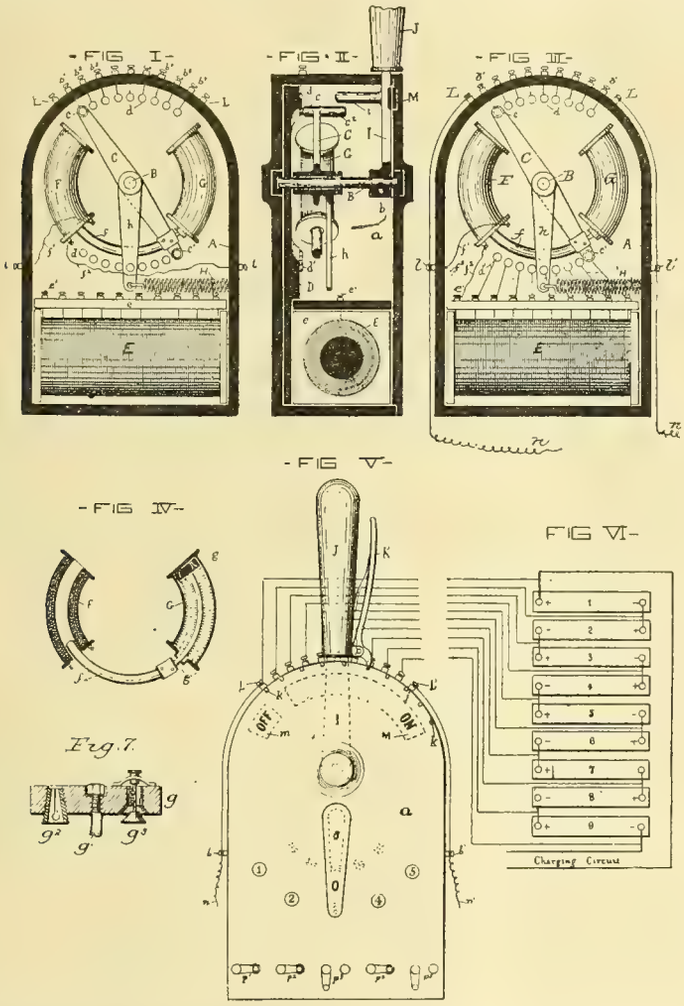
The operation of the device is as follows: When the circuit closing lever provided with the handle is moved from its normal (open) position on the left of the apparatus to a point on the curved plate—say to the extreme right of the apparatus—only the current from the first cell of the secondary battery will flow through the brake circuit. The solenoid, however, being energized to a certain degree by the derived current passing through it, now begins to attract the core and moves the contact lever to the second contact point, thus throwing two cells into the brake circuit and proportionately increasing its own force. This process continues, each additional cell thrown into the brake or working circuit also increasing the force with which the core is drawn into the solenoid; but as the dash-pot is adjusted to limit and regulate the rate of motion of its piston rod, the movement of the contact lever across the face of the contact points is rendered uniform, and additional cells are thrown into the brake circuit until the entire battery is included therein.

If, however, it is not desired to send the entire strength of the battery into the brake circuit, all that is necessary is to move the switch-lever along the curved contact plate, but not so far to the right as before, it being retained in posi-

tion by the segment pawl. The operation will then be the same as before, except that when the contact lever has moved forward sufficiently it will come in contact with a projection on the regulating lever, and its further motion thereby arrested.

In case the cars are operated by electric motors deriving current from a central station, the storage batteries are replaced by resistances, so that the brake coils are gradually connected to the main source of current. This arrangement is also shown in Fig. 8.

From what has been said, it will be seen that the circuit closing apparatus is not only adapted to regulate and control the admission of current to the electro-magnetic brake devices just described, but is equally applicable to other forms of service, such, for instance, as incandescent lighting, in which it seems well adapted to prevent the premâture wear or decay of the incandescent filaments now occasioned by the changes in temperature, due to the sudden manner in which the current is usually turned on or off. This is a great improvement, and further developments are expected.



Scranton's Electric Street Railway.

Wilson T. Soule visited Scranton, Pa., on Friday and Saturday last. He enjoyed a ride over the electric street railroad Friday evening, some three miles to a suburban park at the end of the route says the Rochester *Morning Herald.* The cars were open and lighted with incandescent lights. They ran through the main part of the town at the rate of about six miles per hour. After the suburbs were reached they ran at the rate of ten miles per hour and with the power they had they could have run at the rate of twenty miles per hour. The grades along the route are very steep, in some places, 400 feet to the mile. No difficulty is found in making these grades and the cars stop for passengers to get on or off anywhere. They have stopped and started without difficulty with eighty passengers. The cars run very smoothly, without jar from the motor, and with no annoying noise—simply a slight buzz from the motor, not at all disagreeable. Mr. Soule states that he rode both at night and in the day time, and did not see a horse as much as prick up his ears. The cars are stopped very quickly and easily and started as easily; much easier than a horse car. The cars are large, open excursion cars, and will seat sixty persons. The current generated is 20-horse power and will run two or three cars as easily as one. The people of Scranton are delighted with the electric car system and are crying for more. The time is so much more rapid and the passage is accomplished with so much more ease and comfort that the cars are well filled all the time. The investment has proved a very profitable one both to the investors and to the traveling public, and the chances for any more horse cars in Scranton are very slim.

Henry Likly, who has recently visited Scranton, was also seen. He is quite as enthusiastic as Mr. Soule, and fully corroborates all of the latter's statements. He reached Scranton in the evening and was first attracted by the brilliant lights in what he supposed were the horse cars. Upon inquiry he was informed that they were the new electric cars lighted by incandescent lights. After supper he took a ride out into the suburbs. He says he was more than pleased with the rapidity, the ease and the quietness with which they moved along the streets. They ran around the numerons curves and up and down the grades with no perceptible diminution of speed and with no jarring or unpleasant motion. They are not as noisy as the cable or horse cars, and are stopped and started without the jerking sensation so noticeable in the other systems. The brakeman on the front platform has perfect control of the car and can stop it more quickly than the horse cars can be stopped. The power seems to be unlimited. He was informed that on Decoration day, a large car, with a 50-horse motor, carried 100 passengers up the steepest grades, mentioned by Mr. Soule, with perfect ease. He pronounces the electric cars a perfect success in every particular.

The Gymnotus Electricus.

The electrical man of the Chicago *Times* has some original ideas on a new source of light and heat, which, according to his deductions, might work wonders. The element he speaks of is not new, but the application of the *gymnotus electricus* to household economy is quite novel. But we will let him set forth his own views:

"The early Spanish invaders of South America were greatly surprised at witnessing the performances of the *gymnotus electricus*, or electric eel. They found that one of these creatures was capable of giving a shock that was sufficient to throw a man prostrate, if it did not kill him outright. Humboldt and his scientific companions devoted much time to the study of this interesting creature during their explorations in South America, and carried specimens to France and Germany. The science of electricity, however, was then in its infancy, and the electrical eel was chiefly prized as a curiosity. Subsequently Faraday showed that a Leyden jar could be charged by one of these creatures, and he estimated the amount of electricity it was capable of producing in a given time. He also used the electrical eel for the purpose of magnetizing a small bar of steel.

"It remained, however, for a citizen of Venezuela, Senor Don Miguel Santa Mezzito, to utilize this creature for the purpose of producing light to illuminate his residence. He was educated in Europe, and devoted much time to the study of electricity. On his return to his native country he set about making batteries and other apparatus for the purpose of lighting his house by electricity generated by eels. After experimenting for some months, he succeeded in his undertaking. He is now in this country, and states that he produces by means of eels as good a light as that furnished by any form of electrical apparatus in use in eastern cities. As the eels cost nothing, the expense of the light is nominal.

"There is hope for a cheap and excellent light after all, and gas corporations, electrical patents, and the Standard Oil company may not long deprive us of it. Eels are easily raised and cheaply kept, and Senor Mezzito states that two of them, one kept as a relay or resting while the other is generating electricity, are capable of keeping a large room as light as day. All the working force necessary is a cat, monkey, or some mechanical contrivance that will keep the eel in motion. An eel of ordinary size kept in pure or salt water will furnish electricity rated at eight candle-power. By placing a little strychnine or a solution of Peruvian bark in the water an accelerated circulation is produced in the eel and a much greater amount of electricity is generated. It is estimated that there are eels enough idling away their time in the Amazon and Orinoco rivers to light the entire continent. It would require but a small capital to establish an electrical plant capable of lighting the entire coast, while one shark or sword fish would keep the eels stirred up so that sparks would fly from them as they do from the back of a cat.

"Some of our enterprising citizens should 'take time by the fetlock' and introduce eels here for the purpose of lighting the city. The water of the Chicago river and Healey's slough is so rich that eels would thrive in it as they never do in the streams of South America. The turning of bridges, the puffing of steam tugs, and the passage of canal boats and vessels would keep them constantly stirred up and in good condition for business. A tower could be erected on Goose Island that would throw light as far north as Milwaukee.

"For lighting railway cars, omnibuses and cabs, it is obvious that there is nothing like an electrical eel. The motion of the vehicles would keep it in a high state of excitement till a stop allowed it time to take rest and recuperate. It would not be likely to set the carriage on fire as lamps and candles often do.

"Years ago it was demonstrated that electrical light could be converted into heat or power at the pleasure of the operators. Quite likely a properly constructed electrical eel battery could be used to light the house at night, to operate a burglar alarm after the family had retired, to cook a breakfast in the morning, and to run a sewing machine, grind coffee, chop mince meat, and rock a cradle the remainder of the day. The time will probably come when well regulated families will wonder how they ever managed to keep house without an electrical eel."

CORRESPONDENCE.

From New York.

New York, July 16.—The electrical journalism of this country seems to have centered in New York City up to the present time. The advent of the Western Electrician into the field breaks the rule, but that is no reason why it should not succeed. The electrical fraternity of the East welcome the venture and hope the paper may have a prosperous career. There is no reason why Chicago and the West ought not to support as good an electrical paper as New York or a better, so we shall expect great things of the new comer. It is the general opinion that the Western Electrician is handsomely gotten up, excellently edited, and altogether starts off in a very satisfactory manner.

The long distance lines of the American Telephone and Telegraph company are now in successful working operation between New York and Philadelphia and New York and New Haven. There are twenty-five wires on the Philadelphia line,—twelve circuits of copper wire, and one of iron wire used by the linemen and also for experimenting and testing. This line was built in the most substantial manner at a cost of something near $285,000. In Philadelphia all the wires are underground, Kerite cable being used in wooden conduits. Tests of the wires are made every week and a record kept of their condition, so that the difficulty of locating trouble is reduced to a minimum. The insulation of this line is very high, being 300 to 400 megohms. There is also a circuit to Long Branch from here giving very satisfactory service. The company has two routes to New Haven—one direct of thirty wires or fifteen circuits, metallic circuits being used altogether, and another route by way of Stamford, Norwalk, Bridgeport and Birmingham. From New Haven there are two wires to Providence and Boston and this line is now being increased to thirty wires. Preparations are now being made to construct a line to Albany of about fifteen wires. This will take in all the river towns of any consequence. It is not unlikely that lines will be built west from Albany in the near future. The company has lately taken possession of its new operating room in the Metropolitan building. They have now metallic circuits into all the Metropolitan company's offices and by the use of a repeating coil can connect with all the subscribers of that company's system. Thus any subscriber of the Bell Telephone company of Philadelphia can call up any subscriber of the Metropolitan company in New York, a repeating coil being used both at Philadelphia and New York. The result is not so satisfactory as when the metallic circuit alone is used, as there is more or less induction, but still a conversation can readily be carried on. In the operating room is a section of the Metropolitan company's new multiple board, and as soon as this board is in operation any long distance subscriber can be connected with any Metropolitan subscriber without trunking or sending checks. It is estimated that the time by this method will be about sixty per cent. less than by the old system. This section is equipped for 6,000 subscribers and has a capacity of 10,000. Although the Philadelphia line has not been in operation long, the amount of business done is very satisfactory. There are from one to two hundred calls a day and the number is steadily increasing. The long distance transmitters used by this company are mounted on a handsome desk at which the subscriber sits when talking. A fixed monthly rental is charged for these sets and a toll for all calls. There are about two hundred of these sets in use in Philadelphia and one hundred in New York.

Preparations for the thirty-sixth meeting of the American Association for the Advancement of Science, to be held in this city during the week beginning August 10, are progressing rapidly. The local committee has issued an appeal to the citizens for aid in entertaining the association. Of the 1,900 members, 1,200 are expected at this meeting, and the social feature of the programme will be made very attractive. Excursions have been planned to all the favorite resorts near New York, and it is expected that the meeting will be one of the most successful in the history of the society.

About three hundred and fifty members of the American Society of Civil Engineers did the Catskills during the first week in July, and, according to reports, were treated to a wonderful electric display during a mountain storm. The lightning darted from peak to peak and the thunder crashed in a way that was terrific. The engineers said the war of the elements was a sight long to be remembered and was worth going miles to see. The Society of Civil Engineers, in connection with the American Institute of Electrical Engineers, are collecting funds to either enlarge their present house or to secure new property. It is proposed to secure a building to contain an electrical library, a museum of electrical apparatus, and models and an experimental laboratory. Such an institution would be of great utility and benefit to all resident electricians and scientists, and it is to be hoped that the plan will succeed.

The Board of Electrical Control has ordered the Metropolitan Telephone Company to take down all their wires on Sixth avenue and put them in the conduit.

M. Rotschoupkine, director-general of the Russian government telegraph, is in the city. He was sent here by the Russian government to investigate the American system of telegraphy, and has been making a careful study of the Western Union Company's method of doing business.

C. E. Scribner and W. R. Patterson, of the Western Electric company of Chicago, have been spending the week here on business connected with their company. S.

From Detroit.

Detroit, Mich., July 18.—Within the past few months several capitalists having in view the construction of electric railways have visited this city, among others, to inspect the workings of the electric railways here. The Highland Park railway using the Fisher motor has, on account of its successful operation, during all kinds of weather, generally received close and favorable examination. This is evidenced by the fact that Frank E. Fisher, the inventor, received a notice Thursday last, of the acceptance of his contract to provide eight motors for a railway to connect San Jose and Santa Clara, Cal. The road is eight miles in length. Further contracts are looked for from the Pacific Coast. Mr. Fisher's motor has also been adopted by the Bellevue and Davis Island Incline Plane Co., of Pittsburgh, Pa., and the East Detroit and Grosse Pointe Railway Co. of this city. Work on the latter road is being pushed rapidly, and it is expected that the cars will be running within a few weeks.

Some time ago the city council appropriated $30,000 for the purpose of placing the wires of the fire and police departments under ground within a radius of one-half mile from the city hall. The work has been begun. The conduit adopted is 1½", 2", and 3" iron pipe, laid about 2 feet underground, into which will be drawn the cables. Day's kerite cables are to be used.

The American Bell Telephone Co., began three suits Saturday last in the United States circuit court for the eastern district of Michigan, against first, the Au Sable Lumber Co., and John C. Gram of Au Sable; second, Henry M. Loud, Henry N Loud and Edward F. Loud of Au Sable; third, Bostwick R. Noble of Detroit, William N. McKenna of Brockway Centre, J. T. Waterman and James Benedict of Peck, Alvin B. Graham and Phillip L. Graham of Croswell, Charles Corbishley of Sandusky, Mich., Andrew Moore of Speaker, John Blower of Deckerville, Alonzo Downing of Downington and John P. Niggerman, of Lexington. The defendants in each case are using the Cushman telephones.

The St. Clair and Sanilac Telephone Co., capital stock $5,000, with head office at Brockway Centre, is the latest company desirous of serving the public. A line connecting a few offices in St. Clair and Sanilac counties has already been constructed and it is the intention to open other offices in Macomb county en route to Detroit. An injunction has been applied for, however, restraining the company from using the Cushman instruments. The parties named in the third suit referred to above are the incorporators of the company.

During the prevalence of a severe thunder storm in this city on the 9th inst., a rather curious phenomenon, happily unattended with any serious results, occurred on the premises of Capt. Patton, 38 Hancock Avenue. The family hearing a hissing noise in the front part of the house, entered the parlor to ascertain the cause of it. They were just in time to see a ball of fire, apparently as large as a cocoanut, burst through the wall paper from the chimney. They did not remain to witness the gymnastic exhibition, but fled from the room terror-stricken. The electrical visitor had possession of the parlor only a few moments but managed to do considerable damage during the time. What might have happened, had not the front door been opened by a neighbor who intended to make a call, no one can tell. With the open door and the hole in the wall, a draught was created, and the ball following the current of air, disappeared. Considerable damage was done to the exterior of the house, and it is quite probable that the timely arrival of the neighbor alone saved the family from injury.

Fenton, Mich., is figuring for an electric light plant.

Belle Isle, Detroit's island park, is now lighted by electricity. The Brush company erected a special plant on the island.

The Brush Electric Light Co., is considering the practicability of using oil for fuel. It is estimated that by burning crude oil instead of coal in the furnaces, the fuel bill will be reduced one half.

The Detroit Bridge & Iron Works has secured the contract to build a bridge from the mainland across Detroit river to Belle Isle. The contract price is $280,000.

The Michigan Bell Telephone Co. constructed 140 miles of new line during June. No. 12 hard drawn copper was used.

The Brush Electric Light Co. is building a new station here.

At the last meeting of the Ypsilanti city council the bid of the Jenney Electric Light Co., of Indianapolis, to light the city for $10,875, providing towers, arm lights, etc., was accepted. Mayor Cornwell, however, vetoed the resolution accepting the bid. The company was to furnish five towers, each seventy-five feet in height, and arm lights at every alternate intersecting street, and wherever most needed. It is quite probable that the contract will be awarded over the mayor's veto, as the resolution to accept it was carried by a vote of nine to one. The next meeting of the council will decide the matter. G.

From Indianapolis.

Indianapolis, July 16.—At the conclusion of the meeting of the National Music Teachers' Association, the Governor gave a reception to the visitors and citizens generally in his parlors in the new state capitol building, which was brilliantly illuminated by gas for the first time. The chandeliers are very fine and massive, made for gas and electric lighting. While the building was in process of construction it was wired for electric lighting, and it was the intention of the state house commissioners to put in the necessary machinery for incandescent lighting throughout the building, but finding their funds running short they concluded to use gas for the present, not being willing to take the responsibility of exceeding the limit allowed by the legislature. It is more than probable that the next legislature will make an appropriation for the necessary machinery and fixtures for electric lighting, and order them put in.

Your correspondent dropped in at the W. B. Barry's Saw & Supply Co.'s office this week and found them full of business. They carry a full line of belting, and had just shipped a large belt to the Paris., Ill., Electric Lighting company. Mr. Gallup, one of the firm, showed his new machine for measuring belting automatically, it being arranged so that the belt passing through a series of rollers registers in feet and inches as it runs through, and at the same time is wound up in a coil ready for shipment. This invention will be of value to any firm handling a large amount of belting. Mr. Gallup has several orders for the machine to be shipped as soon as ready for the market.

The telephone toll system is not in favor with the people of Muncie. Many patrons of the company who retained their instruments to give the new system a trial will have them taken out at the end of the quarter.

H. C. Sickels, assistant to J. F. Wallack, superintendent of the Western Union Telegraph company, has just returned from a three months' trip through Europe.

The prospect for Indianapolis having an electric street railroad appears to be very good.

The new cable company, who were granted the right of way on certain streets to operate a cable or electrical railroad, have signified their intention of putting down one line across the city, east and west, this fall, and will use electric motors for power. Application has been made to the county commissioners for right to use the roadway west of the city to Haughville. M.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	385	400
Central Union	45	46
Michigan	76	77
Great Southern	30	33
Colorado	20	22
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27

NEW ENTERPRISES.

An addition to cost $25,000 is about to be built to the Clark house, Minneapolis, Minn.

J. J. McKinney, owner of a hotel at Minneapolis, Minn., is building an extension to the house which will cost $75,000.

Prof. E. D. Eaton, of Beloit college, is building an $8,000 residence at Beloit, Wis.

M. S. Tyler is building a residence block at Kansas City, Mo., to cost $25,000.

S. S. Winn is building a $20,000 residence at Kansas City, Mo. It will be fitted with electric bells and appliances.

Louis Sylvester is erecting a block of residence flats at Aurora, Ill., at a cost of $10,000.

Eugene Stetler is building a residence at the same place, which will be provided with electric appliances.

A new church is to be built at Dyersville, Dubuque Co., Ia., at a cost of from $50,000 to $60,000, Fried Heer is the architect. Rev. Father Gutenkauf is the pastor.

A new jail is to be built at Alpena, Mich. At the same place a hall and engine room will also be built. An electric alarm will be put in the latter. H. L. Powers is chief engineer.

P. W. Power is building a handsome residence at Kansas City, Mo. It will cost about $22,000, and will be furnished with modern conveniences including electric bells.

The opera house at Alpena, Mich., will be remodeled.

A public library building is to be built at LaCrosse, Wis.; the cost is estimated at $15,000.

At Rockford, Ill., J. B. Williams is building a residence, which will cost $6,000.

Creston, Ia., is to have a new city hall. About $22,000 will be expended. The building committee in charge consists of John McCaffrey, W. H. Bradford and R. S. Keith.

The Chicago, Rock Island & Pacific railroad company will erect a passenger station, freight depot and round house at Armourdale, Kan.

The Bolivar Hotel Co. of Bolivar, Mo., will expend about $25,000 on their new hotel. Electric bells will be put in.

D. B. McMechen will erect a residence block in Kansas City, Mo. It will cost about $45,000.

Riley Bros., of St. Joe, Mo., will build a new cracker factory, at a cost of $25,000.

The general offices, machine shops and roundhouse of the Chicago, St. Paul & Kansas City railroad will be erected at St. Joe, Mo.

The new custom house at Lexington, Ky., after plans by Architect Bell, of Washington, will cost $150,000.

The Swedish Lutheran society of Aurora, Ill., is about to erect a new church building at a cost of $10,000.

THE ELECTRIC LIGHT.

Powers' Hall in Rochester, N.Y., which forms a part of that magnificent private art gallery, known by the same name, is to be lighted by incandescent lights The electric lighting of the gallery proper has been so eminently successful that the hall is now to be illuminated by the same light.

The Peabody Electric Light company, of Peabody, Kan., has been granted a franchise to operate an electric light system in that place. The city has contracted for five arc lights and one incandescent light.

THE ELECTRIC MOTOR.

The *Pythian Knight*, published at Rochester, N. Y., under the editorship of William Mill Butler, has an electric motor for power. It is the first paper in that city of good newspapers to use the motor.

The Rochester Electrical Railway company of Rochester, N. Y., has been incorporated for a term of fifty years. The length of the road they will operate will be about six miles, and the amount of the capital stock $75,000. The seven directors, who shall manage the affairs of the company for one year, or until others are chosen in their places, are: Asa T. Soule, Savannah; Wilson Soule, James B. Perkins, H. D. McNaughton, C. B. Judson, Bernard P. Smith, Henry Brinker, Rochester. Among the other incorporators are: David Hays, W. B. Vail, A. Vogt, E. A. Frost, Charles W. Gorton, Rochester, and others. As the name indicates, motors will be used for the propulsion of the cars.

Five miles of standard gauge track will go into operation shortly at Clay Center, Kan., and it is said that electric motors will be used.

An electric railway is being constructed in Graz on the Schlossberg, and a concession has also been obtained for a line from Hainfeld to Ramsau, which will be worked electrically.

THE TELEPHONE.

Frank B. Brown, principal examiner in electricity in the patent office, has submitted to the commissioner his report on the request of Elisha Gray for leave to amend the claim in his application for a patent for the speaking telephone by inserting the word "metallic" before the word "diaphragm" in his original claim. Argument was heard in the case May 24, 1887. Mr. Brown decides adversely to such an amendment, holding that it is concluded by the decision in the original speaking telephone interference cases, and that the subject matter has been abandoned by Professor Gray.

Telephonic communication has recently been established between Cardiff and Newport by the Western Counties and South Wales Telephone company, who have also purchased the business of the Swansea company, started about eight years ago by Mr. Goss. The exchange rates at Swansea, which has thus become connected with an extensive system, have been fixed at £12 for one year, £11 per annum for two years, and only £10 if the agreement is entered into for seven years. Newport has set an example worthy of imitation by other towns, in connecting the houses of fourteen members of the volunteer fire brigade.

The scheme of Professor Barrett of Chicago of opening and closing the bridges by telephone was put in effect on the 20th inst. The plan has been fully set forth in the columns of this paper. For the present the professor will act as dispatcher. The workings of the scheme will be watched with interest and the results will be given after it has had a fair trial.

Miscellaneous Notes.

It seems that in the description of the police patrol signal system, described in the second number of the WESTERN ELECTRICIAN, one feature of great advantage was not brought out. The *Buffalo Courier* has discovered that point of excellence, and describes it in the following incident: "An elderly man with an excited nose yesterday afternoon stood and looked intently and admiringly at a police patrol-box which was surmounted by a gas-lamp. Then he began talking to himself, and he knew what he was talking about. 'That's a big improvement over the old plan, where a fellow had to hold up a lamp-post when he lost his reckoning and fetched up against it. Now he gets inside and the thing holds him up. This is getting to be a great country.'"

THE TELEGRAPH.

One hundred members of the English house of commons have formed a committee for the purpose of endeavoring to cheapen the postal and telegraphic charges between the mother country and the colonies.

A strong and representative committee of men connected with telegraphy and electrical science generally met recently, under the presidency of W. H. Preece, F.R.S., at the rooms of the Society of Telegraph Engineers and Electricians, to deliberate upon the steps to be taken with a view to celebrate by a dinner the advent of telegraphy fifty years ago. The president of the committee was fortunate enough to secure beforehand the attendance of the postmaster-general as chairman of the forthcoming dinner, which will take place on the 27th of July.—*Manchester Industries.*

The Pacific Mutual Telegraph company will extend its lines to Topeka along the Santa Fe railway from Kansas City. Work has already been commenced. J. S. Bear, who recently resigned from the Western Union management at Topeka, Kan., will be the Pacific Mutual's Topeka manager. The line is to be completed within sixty days.

Garden City, Kan. is boasting of a new Western Union up-town office.

Business Mention.

The Union Electric Underground company will establish a factory in Pittsburg, for the manufacture of underground wire. Employment for 300 men will be afforded.

The A. Plamondon Manfg. Co., of 57 South Clinton street, Chicago, have just issued their 29th annual catalogue. Shafting, pulleys, hangers, couplings, machine moulded gearing and flour mill, grain elevator, distillery, brewery and malthouse machinery compose their manufactures.

The Western Electric company of Chicago, has secured a contract for fitting up the excursion steamer Ivanhoe with electric lights.

Leonard & Izard of Chicago are installing for the Edison company a plant of 1200 Edison lamps in the works of Nelson Morris & Co. in the stock yards. The arc lights used on the killing floors, will be replaced by incandescent lights.

At a meeting of the directors of the American Electric Manufacturing company, held at New York, July 14th, the regular quarterly dividend of 1½ per cent was declared, payable on Monday, August 15th, next, to all stockholders of record Saturday, August 6, 1887.

The Owen Sound Electric Illuminating & Manufacturing Co., Lim., of Owen Sound, Ont., are burning 80 arc lamps, distributed over a twelve-mile circuit; and about the 1st of August the company expects to have about 500 incandescent lights in use.

The Western Electric company of Chicago, has just received from the Metropolitan Telephone company of New York, an order for a cable containing 1,000 miles of conductor. It is a handsome order for a first-class cable.

Electrical Patents.

Issued July 12, 1887.

366,195. Undergroundway or Conduit. Sidney W. Arnold and William C. Cranmer, Philadelphia, Pa. Corrugated sheets of metal are placed alternately, back to back. A series of such plates laid in a trough or channel present in section a honeycomb appearance.

366,202. Apparatus for Measuring Electricity. Jules Cauderay, Paris, France.

366,209. Electrical Conductor for Railway Trains. Augustus L. Duwelius, Cincinnati, Ohio. The longitudinal truss rods of adjacent cars are connected by flexible conductor-couplings.

366,212. Electrical Alarm. James A. Galvin, Steelton, Pa.

366,229. Telegraphy. Louis Maiche, Paris, France. The invention is especially designed for use on long cables. A mechanically operated transmitter after each emission of a current automatically sends through the line a current in the opposite direction to restore the neutral condition of the line before the passage of another working current, thus securing uniform duration of alternate signals and clearing the line between reversals of current.

366,263. Underground Cable for Telegraph Wires. Robert F. Silliman, Troy, N. Y.

366,267. Automatic Regulator for Electric Motors. William Stanley, jr., Great Barrington, Mass. A centrifugal governor attached to main shaft of motor, operates by means of a special commutator and brusher to short-circuit certain field coils during such time as may be required to maintain the desired speed.

366,268. Electric-Meter. William Stanley, jr., Great Barrington, Mass.

366,289. Conductor-Support. William P. Zimmerman, Freeport, Ill.

366,292. Car-Lighting Apparatus. Craig R. Arnold, Sharon Hill, Pa.

366,305. Galvanometer. Harry B. Cox, Cincinnati, Ohio.

366,324. Automatic Electric Temperature Regulator. Warren S. Johnson, Milwaukee, Wis. Thermostats and electro-magnets included in a battery circuit operate the dampers of a heating furnace and thereby regulate the temperature.

366,336. Compound for Covering Electric Wires. Henry W. Merritt, Somerville, Mass.

366,337. Semi-Elastic Compound for Covering Electric Wires, etc. Henry W. Merritt, Somerville, Mass.

366,347. Electrical Converter. Albert Schmid, Allegheny, Pa. The invention relates to sheets of iron composing the core of an induction coil.

366,349. Regulator for Self-Exciting Alternate Current Electric Generators. Oliver B. Shallenberger, Rochester, Pa. The invention consists in deriving alternating secondary or induced currents from the primary or generated currents, and causing such alternating induced currents to be converted into a continuous current, which is caused to traverse the coils of the field-magnets and maintain the magnetism of the same.

366,350. Safety-Strip for Electric Circuits. Oliver B. Shallenberger, Rochester, Pa.

366,352. Incandescent Electric Lamp. Edward P. Thompson, Elizabeth, N. J.

366,353. Process of making Incandescents. Edward P. Thompson, Elizabeth, N. J. Hydrocarbon vapor under pressure is applied to the filaments, while, at the same time, they are heated by an electric current.

366,361. Electric Conductor. George Westinghouse, jr., Pittsburg, Pa.

366,362. Electrical Converter. George Westinghouse, jr., Pittsburg, Pa.

366,374. Circuit-Controller for Electric Circuits. Henry M. Byllesby and Philip Lange, Pittsburg, Pa.

366,375. Electric Converter. Henry M. Byllesby, Pittsburg, Pa.

366,376. System or Circuit for Electrical Distribution. Henry M. Byllesby, Pittsburg, and Oliver B. Shallenberger, Rochester, Pa.

366,400. Telegraph Key. Alphonso S. Keating, Corry, Pa.

366,407. Electric Switch. Philip Lange, Pittsburg, Pa.

366,408. Core for Electro-Magnets and Method of Forming the same. Philip Lange, Pittsburg, Pa. The core consists of a sheet of paper covered with soft iron wires rolled together.

366,409. Electric Galvanometer. Philip Lange, Pa.

366,410. Electric Galvanometer. Philip Lange, Pittsburg, Pa., and Oliver B. Shallenberger, Rochester, Pa.

366,457. Laying Continuous Electrical Conduits. Alexander C. Chenoweth, New York, N. Y.

366,513. Electric Controlling and Regulating Device for Pendulums. William S. Scales, Somerville, Mass.

366,523. Automatic Regulator for Electric Distribution. William Stanley, jr., Great Barrington, Mass. The invention consists of an apparatus whereby a current of variable strength is caused to traverse the primary coil of the converter and is automatically regulated through the instrumentality of the counter electro-motive force developed within the converter itself, the variations of which force are caused by and dependent upon the variations of resistance in the secondary circuit.

366,544. Electrical Converter. George Westinghouse, jr., Pittsburg, Pa. The coils are inclosed in an air-tight case, which is surrounded by a strong box, the space between the case and box being preferably filled with gas. The object is to exclude moisture from the coils.

366,603. Mast-Arm for Electric Lights. Frank H. Parker, Burlington, Vt.

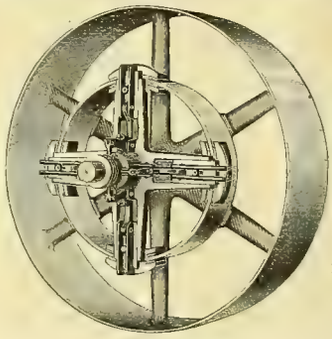
366,606. Key-Socket for Incandescent Electric Lights. Frank L. Pope, Elmora, N. J., and Henry M. Byllesby and Philip Lange, Pittsburg, Pa.

366,613. Electric-Arc Lamp. Addison G. Waterhouse, Hartford, Conn.

366,614. Electric-Arc Lamp. Addison G. Waterhouse, Hartford, Conn.

366,628. Type-Wheel for Printing-Telegraph Receivers. Clarence L. Healy, Brooklyn.

366,634. Electric Switch. Roderick Macrae, Baltimore, Md. and Charles F. Tavener, Boston, Mass.



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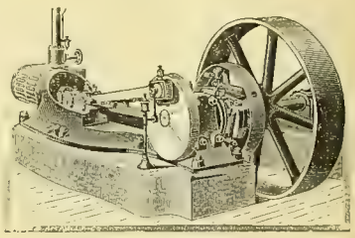

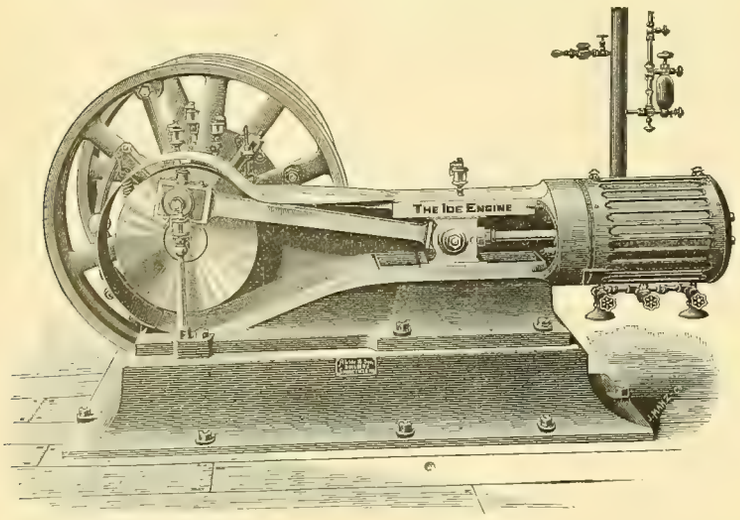

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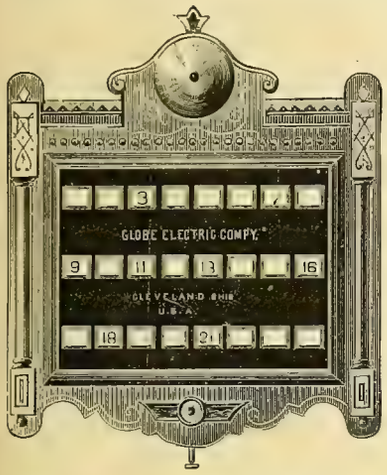

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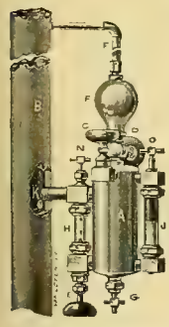

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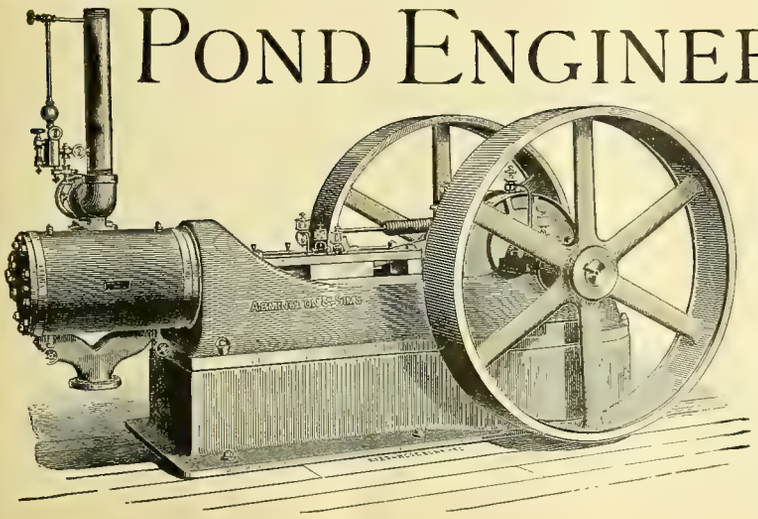

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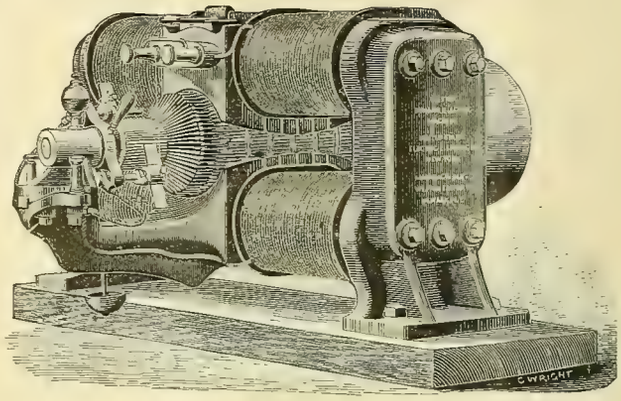

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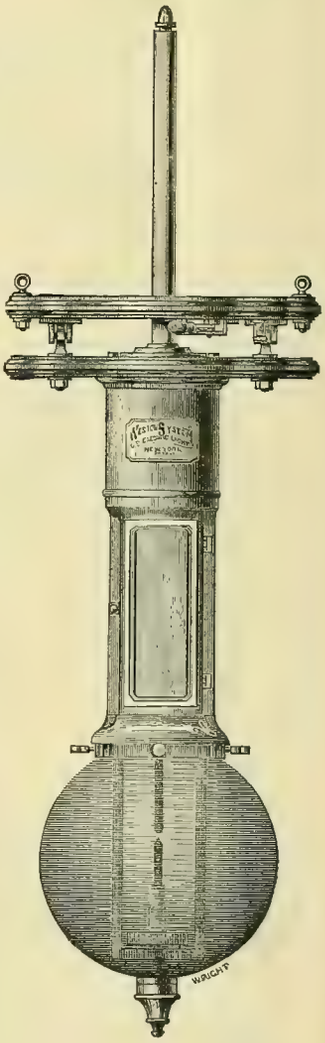

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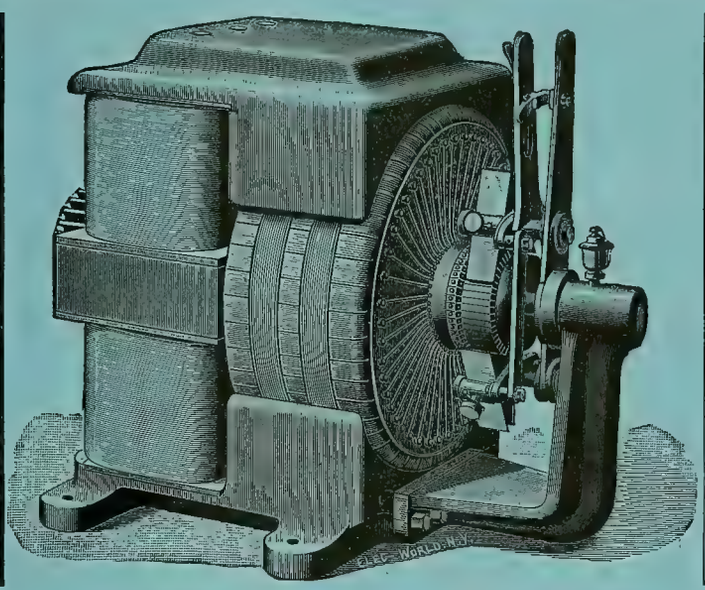

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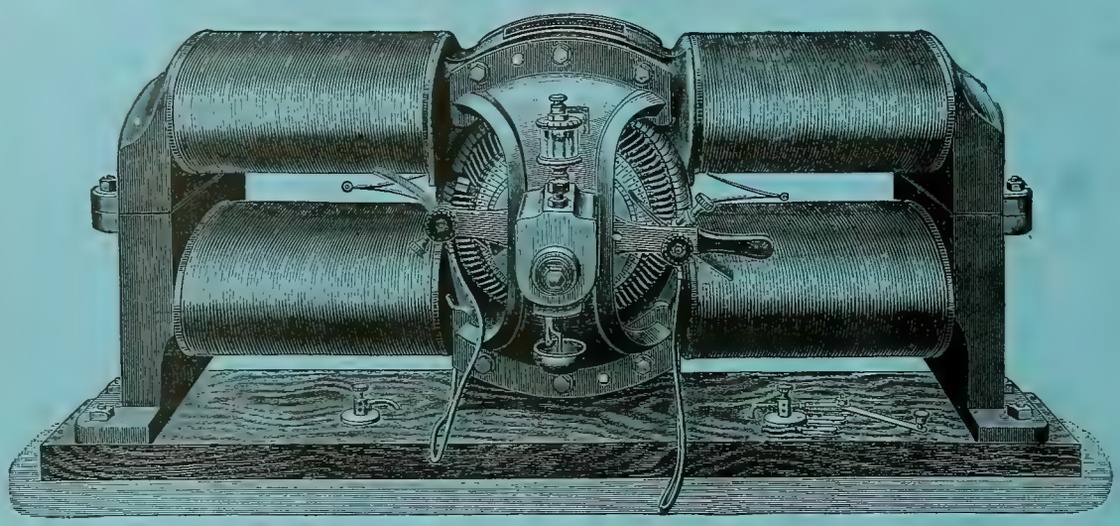

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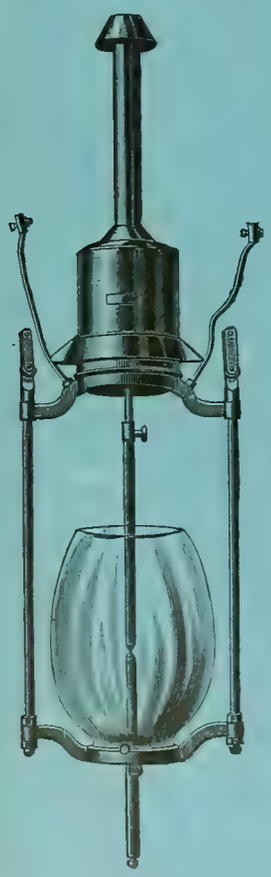

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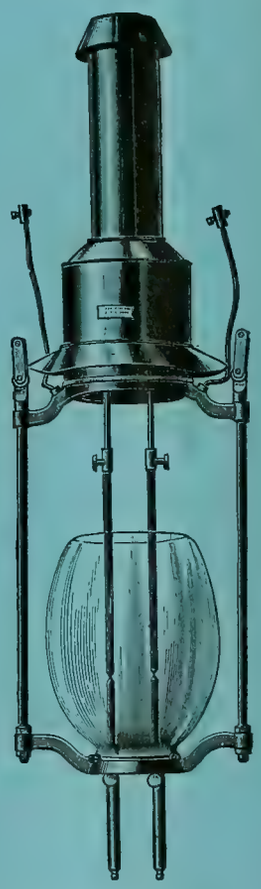

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FULL PAGE ADVERTISEMENT

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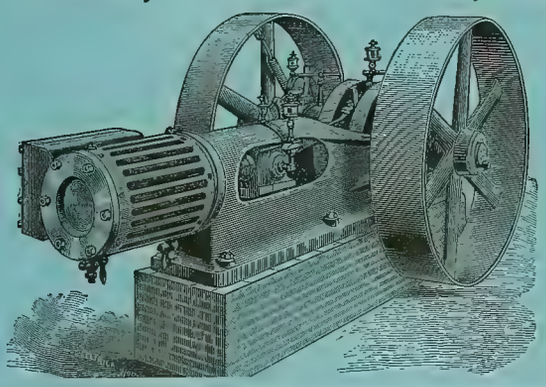

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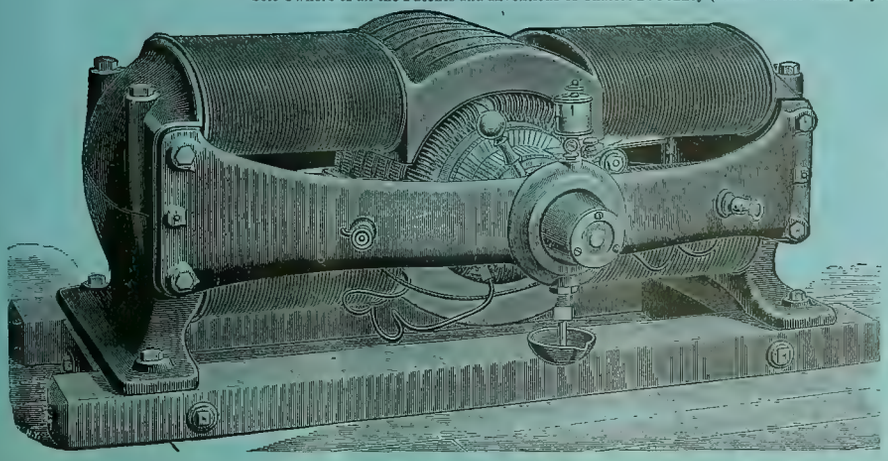

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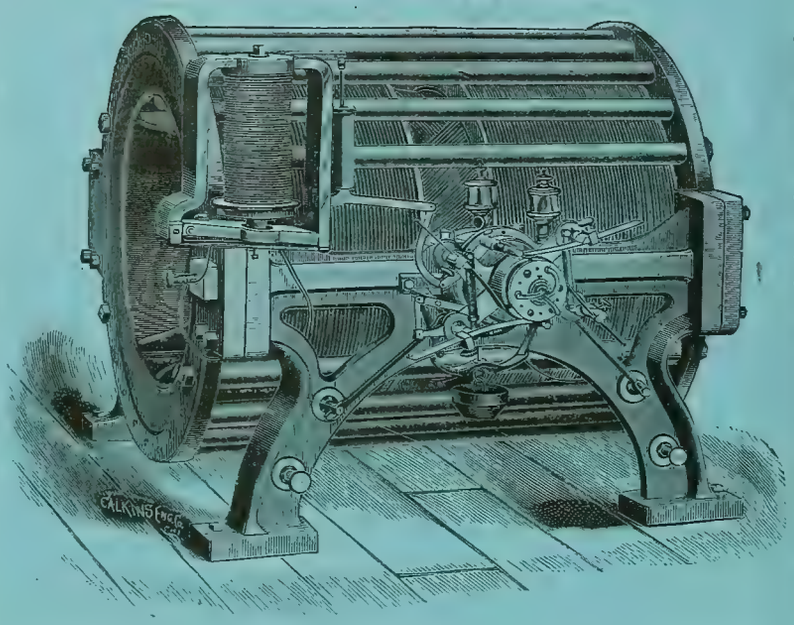

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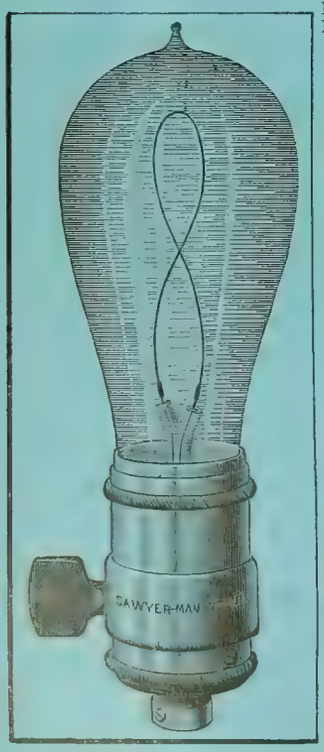

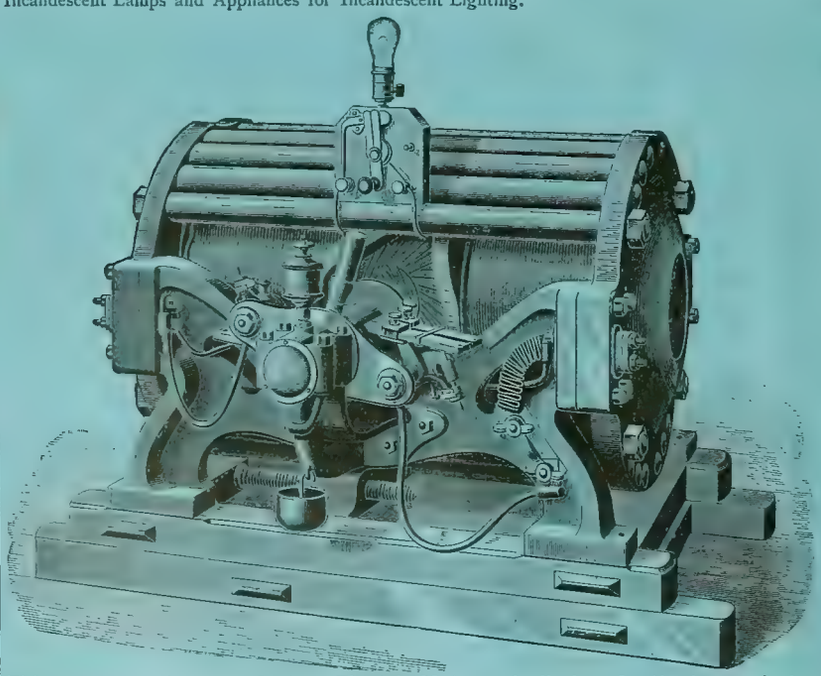

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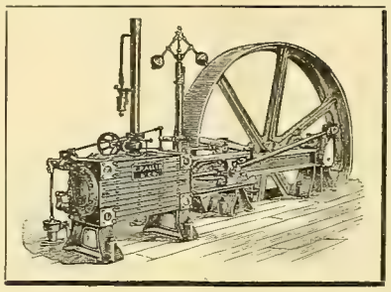

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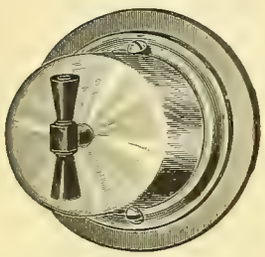

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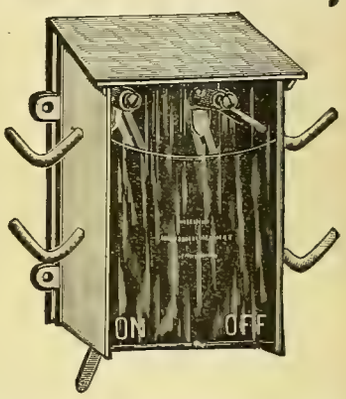

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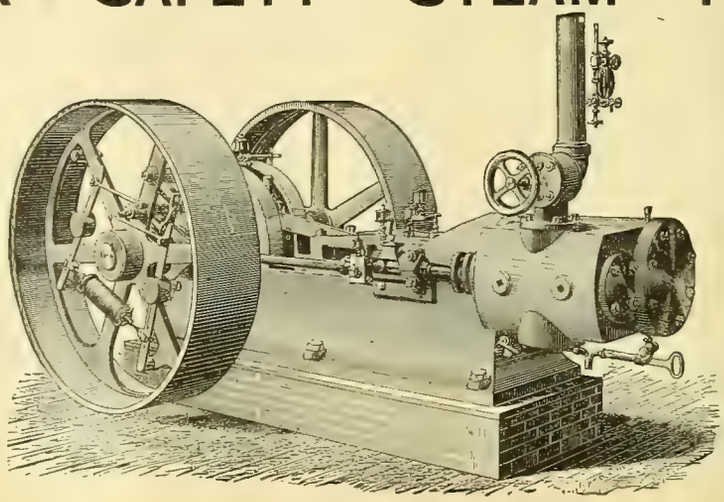

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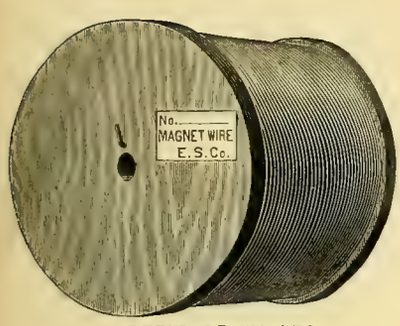

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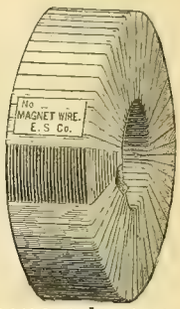

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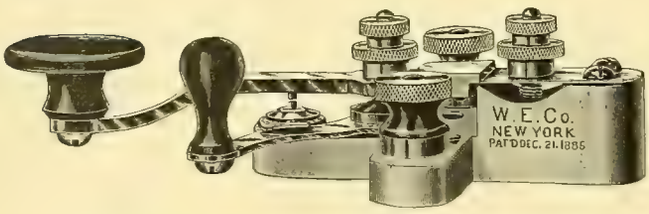

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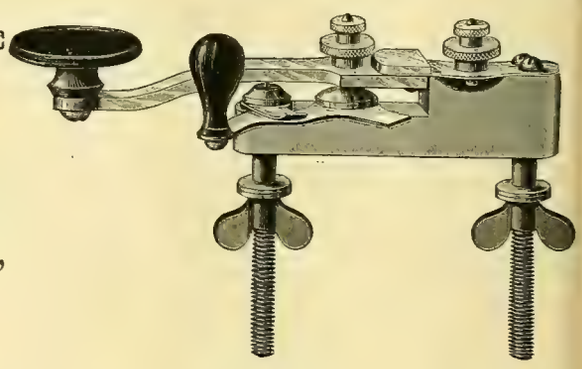

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EVERY SATURDAY.

Vol. 1. CHICAGO, JULY 30, 1887. No. 5.

Siemen's New Ring Dynamo.

Before the Berlin Society of Electricians Herr von Hefner-Alteneck recently read a paper describing a new dynamo made by Messrs. Siemens & Halske of Berlin. From *Industries* we reproduce the accompanying cuts and summary of the paper. The author referred to the statement of Professor Forbes and Dr. Hopkinson at a meeting of the Society of Telegraph Engineers regarding the loss of magnetism in machines as usually constructed, and showed that in the various suggestions for machines with external magnets and internal armature which have from time to time been put forward in order to avoid the dissipation of lines of force, this object is only partially attained. In most of these designs, although there is no external field, there is yet a considerable leakage of lines between adjacent internal surfaces of the magnetic system. If the waste of field were the only consideration the best arrangement hitherto adopted would be that of M. Gramme, where the field system consists of a large circular yoke, with magnets pointing radially inwards, presenting their poles to a ring armature of the usual type. There is, however, this objection, that the machine becomes excessively heavy, and to improve the design Messrs. Siemens & Halske have reversed the relative position of armature and field by placing the latter inside and the former outside. In this way they obtained a star-shaped magnetic field, whilst the armature became a ring of comparatively large diameter and small radial depth, supported laterally on a casting, which was mounted on the spindle. This arrangement as applied to a belt driven dynamo is illustrated in Figs. 2 and 3. Since the armature completely surrounds the fixed poles there is practically no waste of lines, and the close proximity of the magnet cores near the axis insures a much shorter magnetic circuit than is obtained in any dynamo of the usual type. Considerable difficulties were, however, experienced in the practical construction of this machine, and the author found that the formulæ usually employed by the makers in the design of dynamos were totally unfit in that case. One of the difficulties was sparking at the brushes In all modern machines this has been eliminated by making the field magnets enormously heavy in comparison to the armature; but where, as in the present case, the space for the field magnets is limited and the armature is necessarily very large, it is not so easy to proportion the masses in such a way as to secure a sparkless collection. The author found that the radial depth of the ring should be very small, that only one layer of wire should be wound on the armature, and that the commutator must contain a very large number of sections. With attention to these points, and good workmanship, he has succeeded in making a serviceable machine. The armature is 25 inches internal diameter, 8 inches long, and the total weight of the machine is 1 ton 4 cwt. At 250 revolutions per minute the output was found to be 16 kilo-watts, and at 480 revolutions it rose to 25 kilo-watts. Assuming about 20 kilo-watts as a safe load for continuous working, the weight of this machine is less by one-third than that of the usual type made by Messrs. Siemens & Halske. In addition to this saving of weight the machine has the advantage of being easily repaired, since the armature is outside, and can be slipped off the shaft *in situ* without any danger of the wires chafing against the field magnets. After several of these machines had been made Messrs. Siemens & Halske proposed to utilize the design for direct driven steam dynamos. It is evident that a machine with stationary field and overhanging external armature is not suitable for small sizes, and that its greatest advantage and power of competing with existing designs will be in such cases where, on account of the motor, the speed is limited. Fig. 4 shows the arrangement adopted in connection with a pair of open direct acting steam engines; and Fig. 1 is a perspective view of the plant showing the dynamo and its method of connection to the bed of an upright engine The field magnets are attached to the end of the engine bed plate, and the crank shaft is prolonged so as to carry the overhanging armature. Outside the armature there is no bearing, but only the attachment for the brushes, which is secured by means of two columns, also fixed to the engine bed plate. Messrs. Siemens & Halske have now several sizes of this dynamo in hand, amongst which are four large machines for the installation at the railway station in Frankfort-on-the-Main. Each of these machines is intended for an output of 75 kilo-watts at a speed of 150 revolutions per minute.

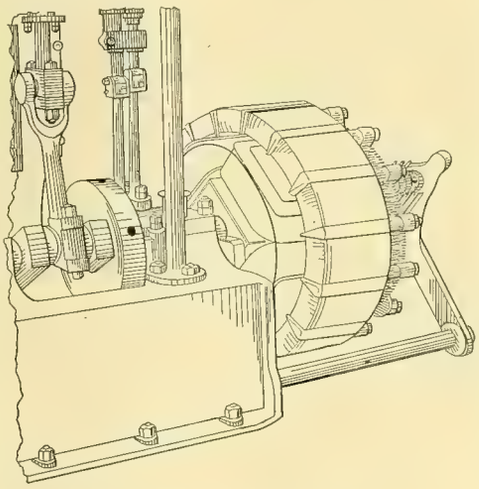


Fig. 1.—Siemen's New Ring Dynamo.

Underground Wires.

At the convention of the National Association of Fire Engineers, at Providence, R. I., Prof. John P. Barrett, superintendent of the fire alarm telegraph in Chicago, read a paper on the danger arising from electric light wires, and the underground system, in the course of which he spoke of the only means of prevention, as follows:

The surest and simplest remedy, the most perfect guard against danger to life and property from electric light wires, is inspection at the hands of some competent party, who should be clothed with authority to compel obedience to his just requirements. Again, the dangers from electric light wires are materially lessened when these are placed beneath the ground, where contact with other wires, roofs and buildings is impossible, and where a loosened wire can not drop across the street or sidewalk. I must strongly urge upon all the great necessity as a precaution, a life-saving measure, of having some check put upon the unsafe method of the electric light people. The methods of accomplishing this are simple, and if an effort is made, can be successfully carried out. The fire departments and the insurance men are natural and friendly allies. If these but pull together for a general purpose they must succeed, and no stone should be left unturned until every electric light plant in this country is subject to proper inspection and control, and every wire, where possible, is put under ground. I will conclude this paper with a few remarks as to why I consider underground wires the proper thing for cities generally, and for fire and police alarm service in particular, together with a short description of the system now existing in Chicago.

It is generally acknowledged that in a large, prosperous and wealthy city, where fire and police departments are considered necessary, a simple, effective and reliable fire and police alarm system is indispensable. Such a system is in use in every large city in the country, and the electrical and mechanical parts of it have been so perfected by the work of earnest and scientific men that, as you know, a child can give an alarm that will at his choice summon either department to extinguish a conflagration or suppress a riot. But with the onward march of science; with the improvement in the equipment of the fire and police department, with the improvement in the mechanism of electrical instruments, and the mastery that man has gained over electricity, the method of stringing wires for electrical use has not kept pace; in other words, the lineman has not kept up with the procession. In any large city in the land you can see huge poles towering aloft, carry tons of iron wire; you can see these wires crossing and recrossing the streets until it would seem as though you could not fire a bullet in the air without striking one. You can seen them fastened to the same old cross-arms, uprights, brackets and insulators that we saw years ago. A menace to life and limb of the passer-by, a hindrance to the fire department and a general nuisance to everybody.

It has long been my conviction that the proper place for electric wires in a large city is under the surface of the earth. Especially is this true of fire and police wires. In a sytem from which so much is expected, where a single broken wire may cause a delay in giving an alarm, involving a loss of thousands of dollars, it seems to me that we should have the wires in a place where wind, sleet and sulphurous gases can not harm them. To be perfect, a fire alarm system must be certain. It should be an absolute certainty that when the hook in a fire alarm box is pulled down an alarm will be given to which the department will respond. We can not have this certainty in our present system of aerial wires, strung in the neighborhood of hundreds of other wires, subject to the destructive action of smoke and storm, liable to accident from countless causes; there is no reasonable certainty that, at the time a box is pulled, the line to which it is connected is not opened or crossed in such a manner as to render it for the time being useless. With a wire of suitable conductivity, well insulated and protected from mechanical injury, placed under ground, we will have this certainty, which the air line can not give. That is the way I feel about underground wires, and I am backing up the faith that is in me by planting those of the Chicago fire and police alarm telegraph as fast as I can get money to do it with. With me it is not a question of hair-splitting argument. It is a question of money, of first cost; outside of that, everything is in favor of underground and against aerial wires, and that seems to be the general sentiment.

The Western Edison company has applied to the city of Chicago for permission to tear up a large number of streets in the center of the city for the purpose of laying wires for a large central station plant.

Cables of the World.

I have a chart issued by the Hydrographic office of the United States navy, says a writer in the Philadelphia *Call*, in which are shown the submarine cables of the world, with the seacoast stations and the principal connecting land lines. It is an interesting map to any one, and I've no doubt of great value to many. In fact, I should imagine it would make one of the most important charts that a mariner could have in his collection. Besides showing the locations of the lines a table of international rates is also given. The conversation to which I had been a listener, you may be sure, started me on a fresh investigation of my chart. Let us take a glance at it together.

The United States, of course, is well ribbed with wires, three lines of which stretch from the Atlantic to the Pacific coast, or at least practically so. Then there are two running from the extreme north to the gulf, while another skirts the Pacific coast. Mexico has a number of lines, while the West Indies appear to lack nothing in this respect. Both coasts of South America as far down as Patagonia have telegraphic communication with the rest of the world, while running into Brazil from Lisbon, Portugal, there is a pair of submarine cables. Did you know there were as many as ten cables connecting the new and the old worlds? They don't run directly across, either. The couple which bring St. Pierre, on this side, and Brest, France, together sweep down as far south as the latitude of New York. Of course you understand that in laying submarine cables the bed of the ocean is first carefully considered.

Europe is crossed and recrossed, while from St. Petersburg clear across the Pacific coast extends a lonely line of wire. Siberia is as bare of poles as the average old gentleman's head is of hair. So is the greater portion of northern and western Russia, the whole of interior China and Africa, British America and Alaska, and, of course, Greenland and Iceland. Australia has several lines of wire running its length, one of which comes clear from the north, where the cable from British India emerges from its watery bed, down to Tasmania. Suppose, now, a California merchant wants to telegraph a correspondent in New Zealand. That isn't so far, geographically speaking, but from a telegraphic point of view it is far in the distance. The California man would send his message something

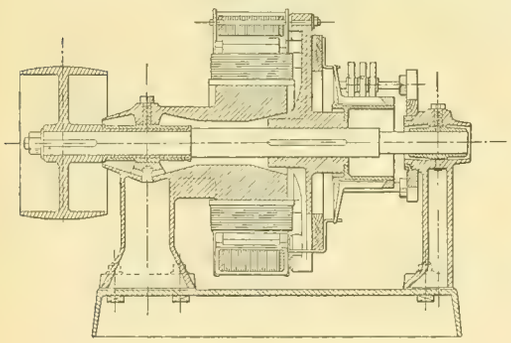


Fig. 3.—Siemen's New Ring Dynamo.

like this: He would start it across the continent, where it would take a journey under water, be flashed through Europe, again under water in the Mediterranean Sea, through the Suez canal, across India, under the Bay of Bengal, the Java sea, a piece of the Indian ocean, and finally to the operator at Palmerston, Australia. He would start it across that continental island to Sydney, where it would take another bath, this time in the Pacific ocean, and finally it would be delivered to the man to whom it was addressed.

Electric Tram-Car.

A private exhibition was recently given to representatives of the London press of Jarman's self contained electric tram-car. The *Builders' Reporter and Engineering Times* says of the experiment: The car, constructed to carry 46 passengers, a very heavy vehicle, and now fitted up with Mr. Jarman's electric machinery, was put to practical tests in the yard of the patentee's works, in the presence of a number of Press men and scientists with the most satisfactory results. The experimental line in Electric lane has an incline of 1 in 40, and a sharp curve of 43 feet radius at the upper extremity. Up and down this the car was propelled at various speeds, some of which far exceeded what would be permitted on public roads. So greatly was it under control, and so powerful was Mr. Jarman's improved brake-power, that, when running at eight miles an hour, the car could be brought to a dead stop in half its length (and this on an incline); when its speed is but six miles an hour it can be pulled up in six feet or even less.

The construction of the car, so far as the

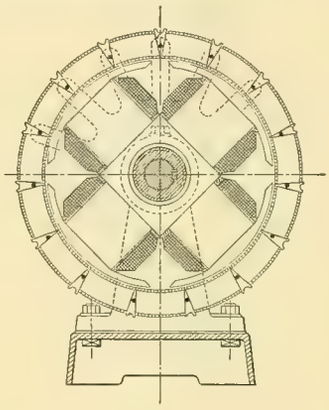


Fig. 2.—Siemen's new Ring Dynamo.

motor power is concerned, may be thus briefly described: Seventy E. P. S. storage batteries are placed under the seats. An electric-motor, constructed according to Mr. Jarman's patent is constructed under the floor and between the wheels of the car, which can be controlled by the driver from either end. In describing this motor, we will borrow from the text of Mr. Jarman's patent a description which will be intelligible to all electricians:

"Two armatures are fitted upon one axle with its field magnets so arranged as to form one compound electro-motor, one armature so arranged as to give motion in the other direction, the axles of such electro-motor having a suitable means attached to it for the transmission or communication to it of motion or power."

The second head of Mr. Jarman's patent claims: "Any suitable mechanical contrivance attached to the electro-motor, or commutator for lifting or removing the wire brushes or plates from the collectors or commutators of one armature and placing the wire brush or plates on the collector or commutator of the other armature, so as to enable a reverse motion of such motor, vehicle, or machinery without any of the usual reversing gear."

Two brakes are provided of a novel description; the brake wheels being placed upon the axle of the electro-motor, four wooden blocks grip this wheel by pulling a lever at the end of the car.

The car is lighted throughout by electricity.

The quantity of electricity to drive the car is not great, so that there is every reason to believe that the cost will not exceed 2½d. to 3d. per car mile run, a very evident saving over horse traction. Moreover, the cost of keeping up the roadway will be reduced. The wear of the rails would be the only expense, because, horses being absent, there would be no wear of the granite cubes between the rails except that caused by the ordinary traffic outside the car traffic.

The car, carrying 46 passengers, has been tested on the actual tramway line. It was driven up the steep incline on Brixton Hill; it was loaded with 52 persons at Water-lane, and then started on its way to Westminster. It was soon found that the speed was approaching fifteen miles per hour; this was slackened, and the speed kept at about seven miles an hour. Stoppages were made along the route, and the journey, in every way satisfactory—terminated on its return to Brixton. A trial upon the common macadamized road (leaving the rails) was made upon the return journey of the car from Westminster. The car was run from the railway bridge, Brixton road, to Electric lane, Atlantic road, which it accomplished readily.

Electric Accumulators.

At the present time much interest is excited in the electrical world by storage batteries. When first introduced as a practical apparatus, some years ago, they were hailed as providing for the storage of electricity, which was considered a great desideratum. For awhile interest in them weakened, but it has revived again. Their acknowledged failure in returning the full quantity of electricity with which they are charged is offset by the consideration that they can be charged from the cheapest possible source of that form of energy, the dynamo. This loss of electricity is due to several causes, some, doubtless, unknown as yet. In charging accumulators, the current has to be maintained at a tension slightly greater than that producible by the discharge. Otherwise the battery would discharge itself through the dynamo, hence there is an inevitable loss in voltage. This does not apply to the natural voltage of the cell. There is a "spurious" voltage, as Prof. Forbes has recently termed it, to contend against. The regular electro-motive force being two volts, the initial tension of the cell is sometimes as high as two and one-fourth volts, and the charging has to be done against this, indicating in such a case a waste of about 11 per cent. of the electro-motive force of the charging current. This is not the only loss, for the tension is not alone reduced, but there is also a fall in quantity or intensity. The ampere hours suffer in somewhat the same proportion.

Thus tests of Faure accumulators have given the following results in electricity returned: Return in quantity (ampere hours), 84.34 per cent; return in electrical work (watts hours), 62.44 per cent; return in mechanical work (foot-pounds), 46.50 per cent. The figures in the three cases are the results obtained by Messrs. Monnier & Guitton with Faure-Sellon-Volckmar batteries, in October, 1883. They are still considered authoritative. For working figures 90 per cent, 60 per cent. and 40 per cent. are sometimes taken. The cause of these different losses is not yet satisfactorily ascertained.—*Scientific American.*

Portable Electric Light.

Herr Friedländer, of Berlin, has designed a portable electric light. It consists of a portable battery with an incandescent lamp attached, for ordinary use. The electrodes consist of carbon blocks and zinc rods attached to an axis which can be turned from the outside by means of a

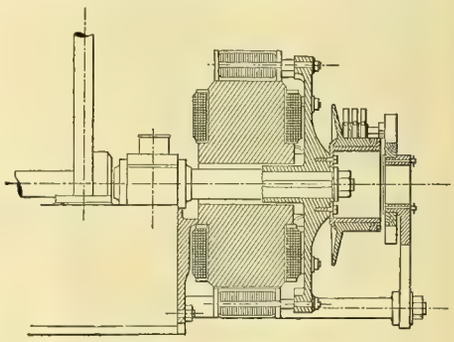


Fig. 4.—Siemen's New Ring Dynamo.

knob, so that when the light is not required the electrodes are turned into a horizontal position clear of the liquid. By lowering them more or less the intensity of the light can be regulated. The exciting fluid is a solution of chloride of zinc and bichromate of potassium, and has no fume or smell. With a 3 c.p. lamp, one charge of the electrolyte will last for about three and a half lamp hours. The exhausted liquid must then be poured away and fresh solution poured in, an operation requiring no more skill than the filling of an ordinary oil lamp. The carbon electrodes, which are specially prepared, do not need renewal, but the zinc rods must, of course, from time to time be replaced. This portable battery and lamp is intended for use in warehouses and other places where ordinary lamps are inadmissible on account of fire risks, and also for use in bedrooms and other places where light is only required for a short time.

Overhead Wires in New York.

The New York Board of Electrical Control has adopted the following rules concerning overhead wires:

No two lines of poles shall be on the same side of any street or avenue.

No two lines of poles bearing conductors for similar electrical service shall be on any street or avenue.

Electric light poles shall be of iron, at least twenty-six feet in height, with a diameter of not more than eight inches at the base, and having cross-arms of wood, with glass, porcelain or rubber insulators, and painted a uniform color.

Poles for telegraph, telephone and other similar wires shall be at least sixty feet in height.

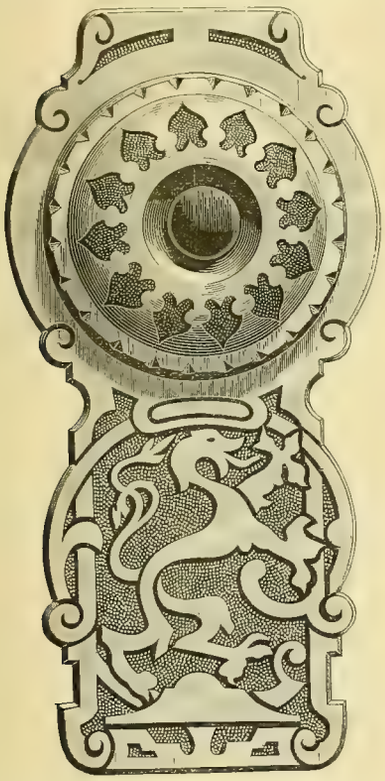
No wires shall be stretched within twenty feet of the ground or within four feet of any building, except when attached thereto with glass, rubber, or porcelain insulators.

No arc electric light or power wires shall be stretched over any part of any house or other building.

The companies or persons owning or controling poles in any street or avenue shall allow the same to be used by other companies or persons operating conductors for similar electrical service when authorized so to do by the board, on tender of proper compensation.

All permits of the board for overhead wires and fixtures are granted only pending the providing of underground accommodations. No such permit shall be granted for any street in which underground accommodations have been provided or are being provided.

Any pole that shall lie on any street more than



two days shall be removed by the Bureau of Incumbrances at the expense of the owner.

The violation of any of the rules shall operate as a revocation of the permit held by the company or person guilty.

Commenting upon this action of the board the New York *World* says: "The Board of Electrical Control has taken up the subject of the management of overground wires and poles pending the time when the wires will be all removed from the streets and placed in the conduits under the surface. The commissioners claim that the law gives them authority over the whole matter of electric conductors in the streets, both over ground and under ground. There is no question that they have full power to say on what poles and in what manner new wires shall be strung, and there can be little doubt of their right to regulate or change existing wires in such manner as the public safety demands.

"The commissioners propose that all unsafe and improper poles shall be removed; that electric light wires shall be hung on iron poles and all companies shall be at liberty to string their wires on paying a fair compensation to the company owning the poles; that only one line of poles shall be placed on any street; that perfect insulators shall be used, and that no arc electric light or power wires shall be stretched across any house or building. Other rules are laid down, suggested by the Commissioner of Public Works.

"This is a very desirable movement. It will not interfere with or delay the burying of the wires a single day. But some time must elapse before they are all under ground, especially in sparsely populated parts of the city, and these rules will reduce the discomfort, disfigurement and danger of the overground wires to the minimum."

New Styles of Push Buttons.

On this page we show two new designs of electric push buttons recently placed on the market by the Electrical Supply Company of 171 Randolph street, Chicago, and 17 Dey street, New York. These buttons are furnished in all the different finishes, and, as the illustrations show, they are very artistic.

Regulator for Dynamos.

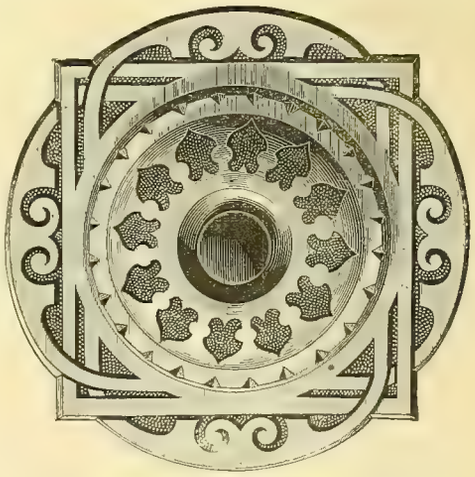
Francisco Vivo Y Graells & Vda E. Hijos de Juan Coma Y Babra, of Barcelona, Spain, have devised a regulator for dynamos which is said to be very simple and easily managed. There are two cone pulleys placed parallel with each other, one of them being set in motion by the steam engine or other motor, driving the other one by a belt, and the latter cone transmitting motion to the dynamo. With two parallel cone pulleys the speed is varied by the sliding or shifting of the belt along the surface of the cones, and the greater the circumference of the first embraced the less the circumference of the second embraced, and vice versa, so that, as the belt is shifted in one direction or the other, the number of revolutions of the dynamo will be increased or decreased. The belt is guided by forks fixed to a carrier that is guided in a frame placed intermediate and parallel with the axis of the two cone pulleys. This carrier is moved in two directions by means of two screw rods journaled in the guide frame, and turning in opposite directions, and by an anchor vibrating between two electro-magnets, and a cross-beam forming part of the anchor which has lugs intermittently engaging the screw threads of one or the other screw rod, and of a spring bar secured to or connected with the anchor, and provided with pawls at its ends that engage with ratchet bars. The teeth of the opposite bars are oppositely inclined, for holding the carrier from moving while the anchor is at its central or normal position. There is an electric connection which actuates the electro-magnets of the carrier, and that may be either the same produced by the dynamo, or by an excitive engine in a manner that the current must pass through one or the other electro-magnets, in proportion as the main current increases or decreases, and for that purpose there is employed an ammeter, the pointer of which, by its movements to the right or left, opens or closes the circuit to one or the other electro-magnets of the carrier. When the regulator is in operation any number of lights within the capacity of the dynamo can be turned off or on, and the light of the lamps remaining in action have practically the same intensity. This invention is applicable to any form of dynamo.

A Valuable Station Indicator.

A person travelling regularly on the surface or elevated roads witnesses the result of the want of an efficient station indicator. Such a device has been invented and patented by Robert Senftner, secretary of the Columbia College Law school in this city, and is now in use on the Thirty-fourth street branch of the Third avenue elevated railroad. On the ground or road-bed, outside the rails, is placed a piece of timber about ten feet in length and six inches wide, with a gradual rise from either end of about five inches to the centre. Depending from either side of the car, attached to its trucks and operated by a simple mechanism, is a lever, to the extreme lower end of which is attached a wheel. When the car is in motion between stations this lever and wheel run over the projecting-piece, thereby touching a movement which draws the chain that runs from the bottom of the car up and into a clockwork which is placed in the centre or at either end of the car. The clock has two dials, showing either way, the hands of which are operated by the movement described. Each dial bears on its surface a list of stations. The hands indicate the next station at the moment the lever passes over the projecting piece. A gong sounds when the hands change. The device is entirely automatic and indicates when the car moves either backward or forward. It cannot get out of order. The indicator can be used on elevated and surface, cable and electric cars.—*New York World.*

Welsbach Incandescent Gas Light.

A large company assembled at the Marlborough gallery, 53 Pall-mall, on Tuesday evening, to witness the display of the new gas light invented by Dr. Auer von Welsbach, of Vienna. The system may be briefly described as follows: In a solution containing oxides of the elements zirconium, lanthanum, and some others—combined in a manner which is the Welsbach company's secret—a conical mantle or hood of cotton net, some three inches high, is steeped. This is then ignited, and the cotton burns away, leaving a residuary skeleton of the incombustible oxides. This, fixed in a glass chimney, is then placed over a Bunsen or atmospheric burner, which may be attached to any ordinary gas-pipe, and on the gas being ignited the mantle becomes powerfully incandescent, and emits a white, brilliant, and perfectly steady light, scarcely to be distinguished from the incandescent electric light, except from its being equally distributed over the whole of the mantle. The effect of the 56 Welsbach lamps in the Marlborough gallery on Tuesday night was most satisfactory, and the most delicate color of the pictures could be seen as



well and as truly as by daylight. Moreover, it has been established that the new light has various advantages, economical and other, which seem to assure its success. It burns up all the impurities of the gas, giving off no carbon and no sulphur, and comparatively little heat—an immense boon to all householders who possess books, pictures, or anything else to which gas is an enemy. It effects a great saving of gas; for whereas a standard argand burner, consuming 5 ft. of gas per hour, gives the light of 16 candles, the Welsbach, burning 2½ ft. of gas per hour gives the light of 20 candles. At this rate the Welsbach may be said to beat the ordinary standard gas burner in the proportion of 40 to 16. The mantles, which are very brittle and require somewhat delicate treatment, are said to last from 800 to 2,000 hours—say from four to nine months in an ordinary house—and are easily replaced at no great cost.—*London Times.*

Mr. Dusenberry—"I saw an immense electrical plant down town. It is very evident that gas" — Mrs. Dusenberry—"Was it in bloom, dear? Why didn't you bring me a cutting?"

Electric Welding.

By Professor Elihu Thomson.

It is the purpose of this paper to describe a new process, which has been termed "electric welding" by me, of utilizing the heating power of heavy electrical currents.

The process is a simple one, and may be said briefly to consist in pressing tightly together the pieces to be welded, and then passing through them an electric current of large volume but low electro-motive force, a very small length of the pieces on each side the abutment serving as a way for the current The resistance at the point of contact of the two pieces gives rise to heat sufficient to weld them, and the squeezing or pressure perfects the union, with often some little expansion or bulb at the union, due, of course, to the approach of the pieces under pressure.

The only metals which it has been easy for blacksmiths to weld are iron, steel, gold, platinum, and one or two others. Blacksmiths seldom try to weld two bars of copper together. Gun metal, lead, aluminum, German silver, and several other metals and alloys have never yet been truly welded. But with electricity not only can all these metals be welded, but also metals of different kinds can be nicely united, and it is interesting to note that some of those metals which were not weldable by the ordinary method are those most easily handled electrically. Of course, such metals as iron, steel, platinum and others—the weldable metals—can be united electrically with the utmost ease and certainty. Pieces of different metals may resist welding because of peculiarities in the metals themselves; but in the Thomson-Houston Electric company's factory there are specimens of the following metals that have been welded together: Brass to copper and steel and German silver; copper to brass and iron and German silver; brass to iron; iron to steel and German silver; German silver to steel and bronze; cast iron to steel; bronze to iron, etc.

An enumeration of some of the possible uses of electric welding may be of interest. Instead of soldering lines of lead and iron pipe, it will now be more convenient to weld them; tubing of any kind can be welded end to end very easily, and wrought iron pipe for ordinary street service could be laid continuous, without the sign of a weld, or, if preferable, with collars welded to the pipes at the joints. The process will also be useful in manufacturing and mending endless bands, such as tires for wheels, band saws, etc. There are in constant use in the factory of the Thomson-Houston Electric company at Lynn, Mass., band saws welded by means of electricity, and there also may be found many other specimens of such work.

In joining wires end to end for various purposes, this new process of electric welding will be very useful. In line construction, in making joints in wires for coils of magnets, and for various other purposes, the process has been in use in the Thomson-Houston Electric company's factory for some time past.

In repairing tools and parts of machinery, and in manufacturing them, there is another wide field of usefulness for electric welding. Screw taps have been lengthened; also drills, reamers, augers, etc., to any required length. New drills and reamers have been welded to the taper shanks of old drills and reamers; and many other tools have been welded satisfactorily by the process. Several pocket knives have had new blades welded to old stumps.

Electric welding may be employed as well for the finest and most delicate work as for the roughest and heaviest. Lengthening pieces have been welded to shafting 1⅜ inches in diameter. Some of this shafting is in regular use in the factory of the company. Larger pieces than this could be very readily welded; in fact, the size of the pieces that can be welded depends upon and is limited only by the power of the apparatus at hand. As an example of fine work I may say that I have welded wires 2-100 of an inch in diameter. This is the smallest work that has been attempted.

The current required to weld by means of electricity is very large. It is probable that to weld copper wire half an inch in diameter there is required a current of considerably over 20,000 ampères; and the same current would be necessary to weld pieces of steel of twice that thickness. The great conductivity of copper—both as to heat and electricity—renders it necessary to employ very heavy currents when welding that metal.

Lack of space prevents me from describing in detail any of the many forms of apparatus that I have invented for the purpose of electric welding. They vary according to the size and nature of the work to be done. They must consist, however, essentially of a means of getting the welding current into the pieces, and a means of holding the pieces during the operation of welding; also a spring or lever or other arrangement forcing the pieces together when they are at the welding temperature. I have fulfilled these conditions in several ways, adapting the apparatus to the character and size of the pieces to be welded. Of course, the clamps are connected with the terminals of the current generator, such as a coarse secondary coil of an induction apparatus, the primary of which is supplied with alternating currents from a suitable dynamo, or, it is possible to use a cell of secondary battery of low potential and very low resistance in place of the coil. The current may also be furnished by the welding machine itself; in one machine recently designed, the power is applied to the machine, the current furnished by it, and the welding done also. Other machines, fully as complete as this, but adapted to different kinds of work, are in process of construction.

Of course, suitable apparatus must be arranged for controlling or regulating the current. There must be a switch for suddenly turning on or off the welding current, for the pieces must be heated rapidly to prevent conduction to the apparatus, and as soon as the weld is seen to be perfect the current must be turned off. It is well also to arrange a means for regulating the strength of the welding current according to the size and nature of the work to be done.

The pieces must be rubbed bright at the ends in order that they may be perfectly welded; this insures good contact. The ends to be abutted must be kept clean and dry for the same reason. Many metals do not require a flux, but it is always best to use a little powdered borax. Care must be taken when placing the pieces in the clamps to have them nicely adjusted, as the perfection of the weld depends largely upon the contact at the points of abutment. It is evident that in welding metals of different kinds together, that the abutment must not be made in the middle of the space between the two clamps. Some metals conduct electricity better than others; some are more readily fusible; one piece may be larger than the other; and in adjusting the pieces these facts must be considered.

Some very interesting specimens of work accomplished may be seen at the Thomson-Houston company's factory, at Lynn, Mass., One of these is two bars of iron welded together with a disc of steel between them; it is impossible to say whether the two bars are welded to the sides of the disc or whether there is a junction of bars, disc and all; but the weld holds well. Another good specimen is a lag screw, shortened by cutting out a section and welding the screw and the square section or head together. This specimen has been tested. It was turned into a block of tough wood and it broke off an inch below the weld, although it was by no means a first-class weld. One specimen of machine steel and wrought iron welded together was tested. The bar twisted twice around completely, and broke at the weld—as could not but be expected, the iron being softer than the steel—on the third twist. Rings have been made of many pieces of metal welded together, and wires have been welded and then literally tied into knots without fracture. Many other specimens have stood tremendous strain, and there can be no doubt that the weld, if perfect—and it can be made so easily,—is at least as strong as the other portion of the bar.

The work can be made as accurate as practice can demand, the degree of accuracy depending, first, upon the aligment of the holding clamps, and, secondly, upon their true adjustment as to relative position when the metals to be welded are irregular in form. The clamps being perfect, with care in adjusting them to the pieces, there is no reason why the weld should not be practically perfect.

Fort Wayne Jenney Incandescent Lamp.

Fort Wayne Jenney Incandescent Lamp.

In the second number of the Western Electrician was described the incandescent electric lighting system of the Fort Wayne Jenney Electric Light Co. We show herewith the style of the incandescent lamp devised by this company for arc light circuits. This lamp is made for seven different candle powers: 16, 20, 25, 40, 75, 100 and 150. A comparison with the illustrations of the lamps of this company previously published shows a difference in the shape of the globe.

An Electric Boiler.

The German Edison company has recently constructed a little boiler which is designed to be used and put up in connection with the regular Edison circuits. The apparatus has within its lower shell a resistance in the shape of a spiral, which is placed under the bottom of the removable pot provided with a handle. The electric boiler is able to raise one litre of water to boiling point in 15 minutes, and according to the rates of the Berlin Edison company, the current consumed would cost about one cent. All danger from fire, dirt, etc., is obviated by this apparatus. The boiler is made of hammered copper, and stands upon an elegant tripod mounted on a polished wooden base.—*London Mechanical World.*

The Book Table.

Practical Directions for Winding Magnets for Dynamos. By Carl Hering. E. & F. N. Spon, New York and London, publishers; 63 pp., 5x7½. Price, $1.25.

The title of the book indicates its scope. As the author states in the preface, the greater part of the articles composing the book was published originally in an electrical paper, but since publication the articles have been entirely revised and in some cases wholly rewritten. Mr. Hering, it goes without saying, is competent to handle the subject, and his book is a useful addition to the library of the expert or of the practical worker.

Theory of Telephone Cables.

By W. R. Patterson.

Number II.

There is in the case of the "bunched cables" such as are commonly used for telephonic circuits, a class of phenomena from which a single insulated conductor of the ocean cable type is entirely free, and which would not be appreciable in any circuit in any thing except telephonic work. That is the presence in the circuit of tertiary and higher induced circuits, caused by the induction from the surrounding wires back upon the primary. If, instead of a circle of conducting parallel wires around the primary, we substitute a uniform no-resistance grounded sheath these would disappear. The loss of energy in the primary, due to causing this electrical disturbance, might be the same in either case and the current received at the distant end might be

Fig.1

the same but the shape of the current would be changed and consequently its effect upon the telephone. The character of this induced current will be modified by the conditions of the conductors which act as secondary circuits, and since they are likely to be very dissimilar at different times, it is not possible to tell in general how much value should be given to this factor. This reflex action goes on like images reflected in opposite mirrors, each one a constantly diminishing *fac simile* of the original. Although these currents are much weaker and propagated in the same direction as the primary, they do not strengthen it, and have a retarding effect. This is due to the fact that, since they proceed from the primary through an intermediate action, they can not exactly coincide in point of time but fall behind. Measuring time by ordinary units, the time by which this effect falls behind the primary would be inappreciable. But using for a unit of time the duration of a current vibration the time of falling behind may bear a very considerable ratio to the time of a complete vibration. Representing the undulations of the primary current by the line *a-a* Fig. 1, if the increased current coincided exactly in time it would be represented by the line *b-b*. Fig. 1. But if it falls behind the effect will be to make the rise and fall of the current as heard in the telephone less abrupt, as in Fig. 2. These figures show a current of symmetrical undulations, like a musical sound or a sustained vowel sound. When the undulations are not symmetrical, as is the case in telephonic transmission, it is probable that an induced maximum will be heard at the time the primary is in an altogether different state as in Fig. 3., when the induced maximum from *y* falling at the point *x* will have a greater effect in obliterating the maximum at *z*.

Besides these factors there are two common ones which can not be neglected. One is the kind of apparatus used. This may be made constant for consecutive experiments, but in the comparison of results obtained at long intervals and by different observers under different conditions, it is necessary to know the kind and condition of the instruments, and if we establish any fixed product of the various factors beyond which transmission is not practicable it must be with the limitation that it applies only to a particular kind of apparatus. The ordinary microphone transmitter will give service when a hand telephone used as a transmitter would not, and in turn it fails where the "long distance" apparatus is a success.

The second general factor is personal equation. The general ignoring of this with regard to results obtained by different observers, or by the same ones at different times and places and under different conditions is entirely unwarranted. The determination depends upon personal judgment, memory, comparison, and the evidence of the senses, while telegraphic results may be made a matter of mechanical record without the intervention of direct personal agency. It is the only modern case on record where an attempt has been made to establish a scientific fact by direct personal observation of time and degree, without reference to the factor of personal equation.

From all these considerations I think it is evident that a circuit where everything but resistance, static capacity, and self-induction could be disregarded would be of interest only as a matter of experiment. It could be obtained only by the impositions of such limitations of time, place and use, that there could be no general demand for its use. The presence of other disturbing causes is a direct and necessary sequence from the time and place in which the telephone is principally needed and used, that is, in large cities where many wires are massed together. Here a certain extent of cable work is an absolute necessity. The conditions are that the cable circuits in the city shall give good service alone, and also when our head lines leading out into the country are connected, or lines leading to other cities where there is also an extent of cable construction. The matter would be simplified if the circuit were all cable or all line wire, but it is not, and can not be so constructed.

Even if CR were a correct measure of the value of the circuit, it is misleading when applied to cables which are to be used with long lines, beyond. The story it tells about the cable is not always true about the circuit of which the cable is a part. The formula says that three miles of cable with a resistance of 20 ohms per mile, and a capacity of .50 microfarad per mile is better than three miles with 60 ohms and .20 microfarad per mile because,

$(3\times20)\times(3\times.50)=90.$

$(3\times60)\times(3\times.20)=108.$

But suppose we combine these cables with a line of eighty miles, with a total resistance of 1,200 ohms and a capacity of 1.2 microfarad: (.015 per mile.) We have in one case:

$(1200+180)\ (1.2+.60)=2484.$

In the other:

$(1200+60)\ (1.2+1.5)=3402.$

But suppose we limit our capacity in the cable to .20 per mile, and make the resistance 200

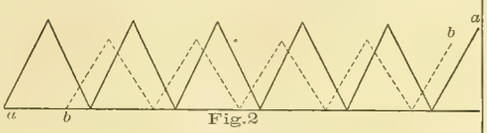


Fig.2

ohms per mile, we have a product of 360 for the cable, but for the whole circuit,

$(1200+600)\ (1.2+.60)=3240.$

Which makes the effect of the cable in the long circuit less with 200 ohms per mile than with 20.

Lightning.

Every one is familiar with the fact that lightning does not spring direct from cloud to cloud or to the earth, but pursues a zigzag course. This is due to the fact that the air is not equally humid throughout. Electricity always takes the path which offers least resistance to its passage. Damp air is a much better conducting medium than dry air—consequently the lightning selects the dampest route, avoiding the drier strata and zones it encounters, and advances, now directly, now obliquely, until it reaches the opposite cloud, where it subdivides into a number of forks. Owing to the resistance it encounters in its path, intense heat is generated, which causes the air to expand. Immediately after the flash, the air again contracts with great violence and with a loud report, which is echoed and re-echoed among the clouds. The report reaching the ear of the listener from varying distances, is drawn out into a series, and, being still further prolonged by the echoes, the roll of the thunder is produced. It is a curious fact that, although the sound of thunder is exceedingly loud when heard near at hand, the area over which it is audible is comparatively circumscribed. The noise of a cannonade will be heard, under favorable conditions, at a distance of nearly 100 miles, while the sound of thunder does not travel over fifteen miles. The occurrence of the thunder and lightning is, of course, simultaneous; but as light travels faster than sound—its passage is practically instantaneous—the flash may be seen several seconds before the thunder is heard. The distance of thunder may thus be approximately estimated, an interval of five seconds between the flash and the thunder clap being allowed to each mile.

Sheet lightning has the appearance of a sheet of flame momentarily illuminating part of the sky or cloud surface. It is, in reality, but the reflection of lightning flashing beyond the horizon or behind the clouds, and at too great a distance for the thunder to be audible.

But the most remarkable of all the manifestations of electricity is globular lightning, in appearance like a ball of fire moving leisurely along, and remaining visible, it may be, several minutes. Many curious accounts are related of its vagaries. One of the most interesting and circumstantial is that given by Mr. Fitzgerald, County Donegal, Ireland, who saw a globe of fire slowly descend from the Glendowan Mountains to the valleys below. Where it first touched the ground, it excavated a hole about twenty feet square, "as if it had been cut out with a huge knife." This was scarcely the work of a minute. For a distance of twenty perches it ploughed a trench about four feet deep, and, moving along the bank of a stream, it made a furrow a foot in depth. Finally, it tore away part of the bank, five perches in length and five feet deep, and "hurling the immense mass into the bed of the stream it flew into the opposite peaty bank." The globe was visible twenty minutes and traversed a distance of a mile, showing that its progress was, for lightning, very slow indeed. During thunder storms of extreme violence on Deeside, balls of fire are occasionally seen to roll down the sides of Lochnagar, which are no doubt identical with globular lightning.—*Chambers' Journal.*

The fact referred to above, that artillery is heard a distance of 100 miles, while thunder is not audible at a distance of more than fifteen miles, indicates that the favorite theory, which assigns the same cause to each—expansion and collapse of the air—may not be correct. The difference in the result points conclusively to the difference in the cause.

The phenomenon of ball lightning, as it is termed, is very imperfectly understood, and it is questionable whether it is not a result of lightning rather than lightning itself. The instance given in our Detroit correspondence of last week illustrates this. The fiery ball bursting through the wall-paper on the chimney, and carried by the air current slowly through the room and open door, indicates that it was either gas from ignited soot or the burning soot itself.

The writer once witnessed a somewhat similar occurrence. Lightning struck a chimney about 150 feet distant, and a burning ball passed slowly down the roof and side of the house to the ground, scorching the weather-boarding. It was apparently about the size of the one recently seen in Detroit, and seemed to be composed of some combustible material.

The Electric Light and Plants.

The winter palace of the czar at St. Petersburg is on festive occasions illuminated by electric light, and the palms and exotics used in decorating the banqueting and other rooms are believed to suffer from the blaze of light. The leaves turn yellow, and dry up, then fall off. The action of the light is thought to be too intense and sudden on them after their transfer-

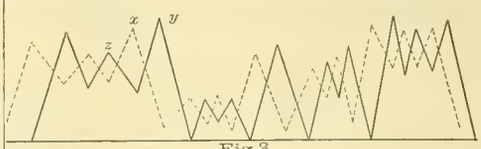


Fig.3

ence from the conservatories where they are wintered. The late Dr. Siemens showed that electric light promoted the growth of plants, and it is difficult to understand how even the bright light of the imperial galleries can have the reverse effect; but so it is reported. The subject is, however, open to further investigation, as there may be other influences at work than the mere illumination. If it should prove to be the latter, the suddenness of the change from the dull greenhouses to the brilliant rooms may have to do with the problem, though it is somewhat singular that a similar effect has not been reported from other quarters.—*London Engineering.*

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ONE of the tales of Wall street in New York is that Messrs. Gould and Mackay have had a conference and that the result will be a termination of the cable war. Like many other tales that have emanated from the same source this information should be taken *cum grano salis*.

As we promised in a preceding number, Professor Elihu Thomson has provided for publication in the present issue an article setting forth the applicability of his system of welding metals by electricity. It is entirely out of the question to enumerate the industries in which this process can be applied at a great saving in both labor and material, but there seems to be no doubt that the invention will bring about an industrial revolution.

OUR readers will be interested in the brief description of Siemens & Halske's new dynamo given in this number. The construction of a dynamo with the armature outside the field magnet is novel, though not entirely new. It involves certain difficulties of construction, arising chiefly from the necessity of a large armature to give room in the interior for field magnets of sufficient size; and hence it is adapted only to large machines. The method in which these difficulties have been met and overcome will be found in the description.

PROF. H. S. CARHART, of Michigan University, was in Chicago this week to complete arrangements with the architect for plans for their new physical laboratory. This has special reference to the department of electrical engineering, recently adopted by the university, which, combined with that of mechanical engineering, is to be opened at the beginning of the fall term, and to be in charge of Prof. Carhart.

The details will soon be completed, and it is understood that the west will from this time forth have in her leading university a department of electrical engineering not a whit behind that of Cornell in the east.

Now how many other western institutions of learning are ready to fall into line, and follow the example of the institution at Ann Arbor?

THE present complications in Hawaii have called the attention of the Pacific coast to the advantages that would accrue to it and to the whole United States by the laying of a cable to Honolulu and thence to Australia. It is urged that commercial relations between the United States and the Hawaiian group have become so intimate that telegraphic communication is recognized as desirable. There is no question but that the press of the country has felt the need of quicker transmission of news than that afforded by dilatory mails. Remote corners of Europe in point of time are in closer proximity to America than this group of islands lying less than forty degrees south-westerly from San Francisco. But the tolls collected for news service from these islands in the course of a services of years would not begin to pay the expenses and interest in the investment, and the commercial importance of the islands themselves would not warrant the laying of a cable. But as a way station for a cable to Australia and the adjacent islands, the Hawaiian group might serve a purpose. A cable connection with the Australian telegraphic system would open a new field of commercial enterprise that in the end would probably prove remunerative.

As the date fixed for the next national Electric Light convention approaches, it becomes more evident that the meeting will be the most important in the history of the association. August 9th and the Parker house, Boston, are the two salient points to bear in mind. According to Eastern advices these facts have already been borne in mind by many, for applications for choice rooms have already exhausted the available space of that character. This fact alone attests much to the importance of the gathering.

DR. HELLMANN, of Germany, has recently discussed the probabilities of lightning. He finds no basis for the conclusion that lightning strokes are increasing, in that country, at least. The striking of any particular building depends upon its height, material, comparative isolation, and the soil upon which it stands. His investigations lead him to the conclusion that for every stroke upon limestone ground we may expect seven on clay soil, nine on sand and twenty-two on a loam. In open plains the danger is greater than in the city. In the kind of trees selected, it appears that an oak is struck fifty-four times against the beech once.

THE telegraph has aided in the capture of many great criminals, but the aid of the telephone has just been invoked to facilitate the escape of the prince of boodlers of Chicago. As our convicted boodler, McGarigle, lay swelting in jail these hot days, he contrasted life in Canada, where his princely stealings would enable him to live in affluence, with life in the penitentiary, and, having matured his plans, telephoned his kind friend, the sheriff, last Saturday evening, that he had an appointment at home, and the confiding sheriff telephoned that he would escort him there—net result—McGarigle skipped.

JULY 22nd articles of incorporation of the Metropolitan Railroad company, capital stock $30,000,000, the principal office to be located in Chicago, were filed with the secretary of the state of Illinois. The proposition of the company is to tunnel the city and suburbs of Chicago in the interests of rapid transit. The design is to lay tunnels thirty-five feet under the surface of the street. On principal streets the lines will comprise four tunnels, two each for trains moving in different directions. The tunnels are to be of brick and masonry, and lighted by electricity and ventilated by powerful fans which will force and exhaust the air. The whole system is to be similar in design to the underground railways of London and Paris. The motive power will be electricity, steam, compressed air, or other suitable power. No charter has, of course, been obtained and no attempt to secure a charter will be made until there is a demand for better facilities than are now afforded for rapid transit to the suburbs. The company is therefore in a state of embryo, but that there is an increasing need for more rapid transit there is no question. As a city, Chicago is still growing at a rapid rate and year by year sees a larger proportion of its business men seeking houses outside of the city and necessarily expending no small part of each day in going to and returning from business or labor. The suburban service of the railroads is in the main very good, but the same difficulty attaches to their service that is a feature in all surface railroads in cities, and that is the necessity of running at slow speed through thickly settled parts of the city. Whether this difficulty will be overcome by elevated or underground railways is a matter of guess-work. The formation of the Metropolitan company shows that capitalists are considering the future of the city with the keen calculating minds of prospective investors. But, be the future rapid transit of Chicago overhead or underground, the application of electricity as the motive power, as a means of illumination and possibly as a means of heating, is destined to play the chief part.

Carpentier's Electrometer.

M. J. Carpentier, described at a recent meeting of the French Academy of Sciences a new form of absolute electrometer, which has the advantage of being perfectly aperiodic. The movable armature, which carries a pointer, is a metal strip about .4 of an inch wide, bent into a rectangle, and either suspended by a torsion wire in the vertical form or resting upon knife edges in the horizontal form, in which case the electrostatic attraction is balanced by gravity. This movable armature can rotate between the coatings of a cylindrical condenser composed of four quadrants. There are thus four pairs of coatings, diametrically opposite pairs being electrically connected. In principle this arrangement is the same as Sir William Thomson's quadrant electrometer, and when not electrified the armature occupies a position midway between adjacent pairs of coatings. If one pair of coatings is connected to earth, and the other receives a charge, the armature following the electrostatic attraction will occupy a new position, in which the torsion of the wire or the action of gravity counterbalances the electrostatic attraction. The novelty of M. Carpentier's design consists in making the coatings of iron, and combining with one pair of them a strong permanent horse shoe magnet, so that the armature swings in a very intense magnetic field. The eddy currents generated in the metal of the armature by its movement through the field tend to retard such movement in very much the same way as the needle of an ordinary mirror galvanometer is damped by being suspended within a thick copper casing. The result is that upon charging this electrometer the pointer moves slowly to its position of equilibrum without swinging backwards and forwards, and the instrument is therefore suitable for very rapid observations.

Radius of a Lightning Conductor's Protection.

The question has often been asked, "What is the radius of the circle of protection afforded by a good lightning conductor?" A well-known German architect, Herr Schiller, has lately thrown some light upon the matter by the publication of facts which came under his observation last June. A pear tree, thirty-three feet high, was struck by lightning, no protection being afforded it by a conductor which stood on a school-house forty yards away, or by another one, 110 yards distant, which was carried to the steeple of a church more than fifty yards high. Both these conductors when tested showed that they were in excellent condition. From these data the conclusion is drawn that the area of protection round a lightning-rod is a space equal to twice its height.—*Building*.

This is a confirmation of the old rule adopted more than half a century ago, and reaffirmed by the English Lightning Rod Conference, Dec. 14, 1881, in the following words: "There is no well authenticated instance of a building furnished with a properly constructed conductor, having been injured by lightning within a conical space, having the point of the upper terminal for its apex and the radius of whose base equaled the height of the conductor."

According to the above rule, it will be seen that the pear tree, and especially its top, was quite out of the range of protection from either of the conductors; the first mentioned being located 120 feet distant, but whose height is not given, and the second, at a distance of 330 feet. The latter was, it seems, about 160 feet in height, and consequently the radius of the area protected at its base could not exceed 160 feet; while the pear tree stood 170 feet beyond the outer edge of this area.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number IV.

The Shunt Dynamo.—Dynamos are divided into two different classes, known respectively as the series dynamo and the shunt dynamo, according to the method in which the field magnets are wound, or the relations of this winding to the main circuit. The same general principles of construction and mode of action apply to each; but in the shunt dynamo there is a specific difference in the mode of action, resulting from the difference in winding. The term shunt, as here technically used, means a route separate from the main line, through which an electric current, or a part of it, may be diverted. If a current is flowing through a wire, and the wire be severed and the break filled by a non-conductor, as air or hard-rubber, the current must cease; but if the severed ends be connected by a wire passing round the non-conductor, the current will pass round through this shunt, and flow on as before. If now the non-conductor be removed, and the original wire restored, while the shunt still remains, the current will divide, part of it passing through the main line, and part through the shunt, in proportion to the relative conductivity of each. If a resistance, as an electric lamp or series of lamps is introduced, either into that part of the main circuit around which the shunt is placed or into the shunt itself, the amount of current flowing through each of these separate routes will be in the inverse ratio of the resistance of each, and hence the introduction of the lamp or lamps into either branch of the circuit will divert a larger proportion of the current through the other branch.

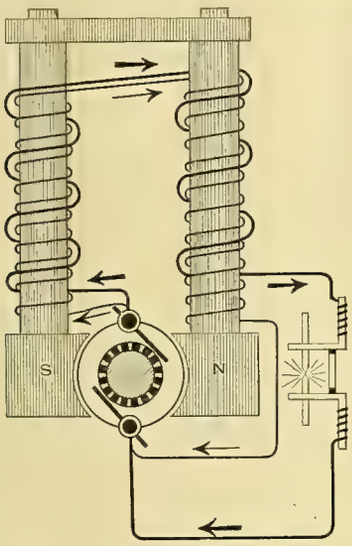

Fig. 9.

The principle of the shunt dynamo is illustrated in Fig. 9, in which are shown the electro-magnets wound with two separate wires, a coarse one for the main circuit, and a fine one for the shunt. These wires are joined at the brushes, as shown, but insulated from each other in every other part of the circuit, both internal and external. Resistance being directly as the length and inversely as the cross section of the conductor, it is evident that if the lengths were equal, the resistance would be much higher in the fine wire than in the coarse one; and that the quantity of current in each would be directly proportional to the area of the cross-section; but by increasing the length of the coarse wire, or introducing a resistance, the resistance in its circuit may equal that of the fine wire; in any case any increase of resistance in either branch of the circuit would, as stated above, divert to the other branch a current quantity proportional to this increase of resistance, just as an obstruction in one channel of a river diverts a greater quantity of water into the other channel.

Now, suppose an electric lamp placed anywhere in the main circuit, as shown; there would be a considerable increase of resistance, and a proportional amount of current would be diverted through the shunt; and as the magnetism of the field has been shown to depend on the volume of current flowing through the field magnet coils, it is evident that the interposition of the lamp, and consequent diversion of current from one branch to the other would not reduce the magnetism of the field.

But suppose the shunt removed, then the resistance of the lamp, as before, reduces the volume of current in the entire circuit, and hence in the field magnet coils, just as an obstruction in a river would reduce the volume of current if there were but a single channel. Reduction of magnetism in the field follows this reduction of current, and reacts on the current itself to produce still farther reduction. Each additional lamp in a series, in the circuit of a series dynamo, increases the resistance and reduces the current in this way, while each additional lamp in a shunt dynamo diverts the current without reduction from the main circuit to the shunt. In the latter case there are of course certain limits which can not be exceeded, but our object is simply to illustrate the principle of the shunt dynamo as distinct from the series dynamo.

It is evident then that the series dynamo is liable to fluctuations in the current from varying external resistance, while the shunt dynamo is self-adjusting, and when a dynamo supplies the current for a number of lamps, this becomes a very important matter. When the lamps are arranged in series, the current passing through from one lamp to another, any change of resistance in a single lamp, such as often occurs, must affect every lamp in the series. In the shunt dynamo, as we have seen, any increase of resistance in the lamp circuit increases the current in the shunt, and by reaction supplies the current necessary to overcome this increased resistance, while a decrease of resistance in the lamp circuit lessens the current in the shunt, and by reaction reduces the current in the lamp circuit to correspond to this reduced resistance, so that in a shunt dynamo resistance has the opposite effect to that which it has in the series dynamo, where increased resistance lessens the current, and decreased resistance increases it. This explanation applies fully to dynamos having a separate external circuit as in Fig. 10, but only in part to dynamos wound as shown in Fig. 9.

There are several different ways of winding the shunt dynamo, by which different objects are accomplished. It is not essential to our present purpose to take them all up in detail, but Fig. 10 illustrates an important application of the shunt method in what is known as the separately excited dynamo. Here, as will be seen, the lamp circuit is entirely independent of the field magnet circuit, so that no part of the current in this circuit is used to excite the field magnets, the shunt circuit alone performing this work. But into the external part of the shunt is introduced a magneto machine, or dynamo excited by a permanent magnet, by which a separate current is supplied, which reinforces that of the dynamo; and this independent initial current assists in maintaining that of the lamp circuit at a constant strength, as required for arc lamps arranged in series.

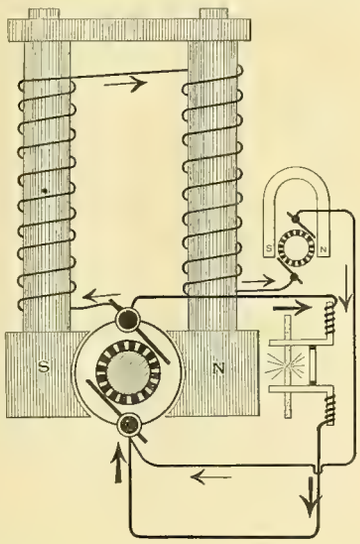

Fig. 10.

In another style of separately excited dynamo, the field magnets are excited exclusively from an external source by the current flowing through their coils in a separate circuit, no part of this current passing through the armature.

The Theory of the Telephone.

M. Corun has presented to the French Academy a memoir by M. E. Mercadier, on the theory of the telephone. M. Mercadier maintains that the transmission of articulate speech is chiefly, if not solely, the result of molecular motion in the plate of the receiver. Vibrations of the plate as a whole are only capable of yielding a single tone and its harmonics; this tone remains unaltered when the plate is supported at various points which are nodal points for this particular note; but under these circumstances the transmission of other tones is much enfeebled. Such an instrument M. Mercardier calls a mono-telephone. On the other hand, a diaphragm supported in such a manner as to be incapable of performing transversal vibration is still able to transmit speech with perfect clearness, although with considerable diminution of intensity.

A New Microphone Receiver.

Herr Hempel, of Leipzig, has succeeded in making improvements in the Gower microphone, by which the clearness of speech and strength of tone is materially increased. In external appearance this new microphone is similar to that of Ader, and in common with it the carbon contacts are not liable to get out of adjustment, the arrangement being such as to make them practically self-adjusting under almost all circumstances. The carbon pencils are arranged star fashion under a wooden diaphragm of about 6 inches diam. The instrument is capable of transmitting the faintest whisper equally as well as a vigorous shout, and there is hardly any change in the color of the tone; nor are there any extraneous noises produced, as is sometimes the case in other microphones. The instrument has been found specially suitable for the transmission of music, a successful trial having been made at the last technical exhibition at Görlitz, where music was transmitted over a distance of one mile. The efficiency of this transmitter is, however, largely dependent upon perfect workmanship, it is said, and this makes it rather too expensive for general adoption.

Tons of Powder Exploded By Lightning.

July 21st, the powder-house of the Chicago, Wilmington & Vermilion Coal Company at Streator, Ill., was struck by lightning, and between eight and ten thousand pounds of powder exploded. Every dwelling on the south and west side of the powder-house was completely shattered, and, in most cases, entirely demolished. Not a vestige of the powder-house remains, while where it stood is an excavation about sixty feet long, forty wide and twenty deep. Strange as it may seem, only one fatality has been reported, but a large number of persons were seriously injured. There were forty-five dwellings almost totally demolished, and not a plate-glass window was left in the business part of the city. The loss will probably reach $75,000 or $100,000.

We have no information as to whether the powder-house was provided with a lightning-rod. The facts on this point. the kind of rod if there was one, its mode of erection, its inspection, or want of inspection, are all considerations of the highest practical and scientific interest.

Novel Application of Electricity.

The covered street at Milan, now well-known as the Victor Emanuel gallery, is roofed with glass and completed by a large dome, around the interior of which runs a chain of gas lamps. The lighting of these lamps at a considerable elevation used to present some difficulties, and was always a source of risk, until an arrangement was made for doing the work by electricity. A miniature railway has been constructed close to the gas burners, on which runs a little electric locomotive carrying a wick steeped in spirits of wine. When it is desired to light the burners the wick is set on fire and the locomotive started on its career. It flies round the dome, rapidly kindling the lights, and exciting much interest among the crowds that assemble nightly to witness the performance.

The Highest Standard.

The Electric Age, July 16.

The WESTERN ELECTRICIAN a new weekly electrical journal, published at Chicago, Ill., has made its appearance. The very first number of this enterprising contemporary conveys the impression that it is in the right hands and will be highly successful from the start. The west needed just such a publication. Its appearance indicates that the highest standard of workmanship throughout will be engaged in its production. The first number consists of 20 pages. It has a blue cover and measures 15x10½ inches. The typography is everything that could be desired, while the paper upon which it is printed is extra heavy and super-calendered. Thirteen of the pages are filled with advertisements, which is the best possible indication of success, especially when we consider the fact that this is not the advertising season. Mr. W. A. Kreidler, who is well-known in Chicago and the west, is the editor and manager. He will be assisted by Philip Atkinson, Ph. D., J. Wayland Clark, and G. G. Minor, M. E. Mr. Kreidler is not a novice in journalism by any means. He has for some years acted as the western representative of the *Electrical World*, in which capacity he has made himself well and favorably known throughout the country. He is therefore thoroughly competent to manage such a paper as the WESTERN ELECTRICIAN is destined tobecome. While we congratulate the editor of this enterprise for the favorable impression the first number of his charge is bound to create, we must also add our praise for the apparent thorough manner in which the entire staff of officers has done its part of the work. The price of the paper will be two dollars per annum.

Telegraph Superintendents and Operators.

In the convention of Railway Telegraph superintendents in Boston, President Swift spoke upon the subject of "The Telegrapher's Union." He strongly denounced that part of the oath which pledges every member not to teach telegraphy to any person without the consent of the chief telegrapher. The association decided to do their utmost to prevent operators from joining the union."

Commenting on this decision, Editor John Taltaval, of the *Electric Age*, said to a New York reporter last week that the Telegraphers' union (National Assembly 45, K. of L.) was not particularly awed, and that the union would continue to deprecate the teaching by its members of telegraphy to beginners without the consent of the chief telegrapher.

"The union," Mr. Taltaval said, "no longer advocates strikes. We have got enough of that unphilosophic kind of action. Our energies are now directed not against the companies, but the two political parties. The George theory of land taxation has taken a strong hold on our members. I myself was recently converted to his views. Our organization is even stronger than it was before the great strike, and its membership is increasing every day. At least 350 of the employes in the Western Union building are believers in the George doctrine, and will vote with the new party. Even some of the superintendents and others who were our bitter opponents during the strike have become converts to the new scheme of land taxation. Telegraphers understand that the highness of rents affects wages. For instance, not one of the companies in the Stock exchange pays less than $2,000 for its office. This and the cut throat rivalry between them makes it impossible for any of them to pay expenses. None of them dares to withdraw from the exchange because of fear of injury to its general business. Of course, if the companies cannot pay expenses they will not increase salaries."

NUMEROUS advance "tips" have been flashing over the wires to various newspapers of the country on the decision of the United States supreme court in the Bell telephone case. The matter has gone over the term and the decision can not be given until fall at the earliest. The record and argument in the case occupy over twenty printed volumes of at least five hundred pages each, and these will have to be carefully examined before a decision can be reached.

CORRESPONDENCE.

New York's Board of Electrical Control.

NEW YORK, JULY 22.—There is a chronic disposition among public officials in this city to do as little work as possible, especially during the mid-summer months, when the facilities for getting away from New York are unsurpassed. The rejuvenated Subway commission, now known as the Board of Electrical Control, after months of suspended animation is, however, showing commendable signs of activity. This is in a great measure due to the positive manner in which the new member, Mayor Hewitt, is making his presence felt. The board has never had any professional electrical advice, but has drifted along, picking up information here and there, depending upon civil and mechanical engineers for a solution of the vexed problem. Now the mayor, commenting upon defective insulation, which he believes is dangerous to life and property, wants to know why a competent electrical inspector has not been appointed, and adds that it is high time this was done. Have we no electrical politicians, or political electricians? This chief inspector, if he is appointed and is a competent man, has a field of activity before him, without reference to the "dangers to life and property," which has been the refrain of the underground agitators in the arc lighting lines in this city, which are a positive disgrace to the business. They must go below or be rebuilt before many years, and then the Board of Control will have a chance to demonstrate what we are here for. Amidst all this talk a certain amount of work is going forward, and the electric light companies will soon have an opportunity to demonstrate whether it is possible to work their systems through the city conduits. The section which will soon be ready for use is on upper Broadway, and is built of 2½ inch iron pipe, scoured inside, and laid in hydraulic cement. Of course, it will be necessary for all conductors to be thoroughly insulated, and there may be a chance for the board to look well to this point; otherwise a failure of insulation may be ascribed to the character of the conduit. The New York, New Haven & Hartford railroad desire the board to "regulate" some foreign wires in the vicinity of the Grand central depot, and taken altogether, there is a prospect of lively times ahead. The Western Union Telegraph company is meanwhile very quietly availing itself of a privilege, which it monopolizes, of placing substantial cables on the elevated railway structures where they will doubtless slumber for years when once placed in position.

Our usual heated term has been very severe on the car horses. Of course, more people ride short distances, when the streets afford no shady retreats, and all of the lines have suffered more or less from loss of animals. The Belt line has had the most severe experience by reason of its loss of 1,400 horses by fire, which compelled the purchase of new stock not hardened to the service. It is admitted by the management of the most important lines that horses must soon be dispensed with, but whether to substitute cables or electricity is the vexed question. Like the Board of Electrical Control, they need disinterested advice, and they don't know where to find it. Mechanical engineers have no faith in electricity, and while electrical engineers believe in mechanical devices, they have unbounded faith in the possibilities of the electric motor. Very few, however, feel positive that the projected cross-town electric railway through Fulton Street will be a complete success, although they hope for the best. It is an exceedingly trying location, and a conduit will have a critical test amidst the greasy slush which prevails in that vicinity during the winter season. The rails have been laid, however, and if certain privileges are obtained from another company for joint use of track, the promoters promise to have the road in operation in ninety days.

Down at Asbury Park, N. J., the Daft people have been busily engaged with a small Italian army in endeavoring to bring their electric railway to completion during the present week. According to the contract, they were to forfeit $250 per day until it was finished, for the very good reason that now is the time when the prohibitionists, our colored brethren, and the festive Jerseyman are flocking to the twin cities by the sea, which have been engaged in a friendly rivalry for years to demonstrate just how puritanically good they could be without depreciating real estate. Ocean Grove takes the cake at present; not a wagon, nor a milkman, nor a newsboy can enter its bolted gates on Sunday; not a cigar or cigarette can be bought at any time, and whether the electric railway between Asbury Park station and the beach will be allowed to violate the Sabbath and make up for lost time is a question of morals which "Boss" Bradley must decide. Meanwhile the Van Depoele people are browsing around for territory, and a company organized under their auspices proposes to build a line in Elizabeth, N. J., between Union depot and the Sound—a distance of two miles—straight, level, and without grades or much way travel. Here will be an opportunity to make good time, and show what electricity can accomplish under favorable circumstances.

There are other things in New York which need regulating as well as electric wires. It was not necessary to order steam boilers placed underground, because they are already there to a great extent; but there is one less than there was a week ago. Since the half-holiday law went into effect, it appears that some alleged engineers have banked their fires, and left matters in shape to breed disaster before they again returned to duty. While this practice may not have been general, it was a fact that last Saturday evening a steam boiler shot up from its position at No. 6 Gouvernor slip, and traveled about three blocks to 194 Monroe street, and now the proprietor of a dime museum who has a surfeit of flying squirrels and flying foxes, offers $500 for this flying boiler, but the obstacle to his getting it appears to be that its wings have been clipped, and its present guardian objects to the rigging of the necessary tackle on his premises to enable it to fly to the Bowery. It is suspected that he may have a dim idea of starting a museum himself with a curiosity which it is to be hoped, will never become a common bird of passage in the metropolis. RALPH W. POPE.

Eastern Electrical Gossip.

NEW YORK, July 23.—The Electric club of this city is in a most prosperous condition, and though one of the youngest of our city clubs, is as vigorous as any. A new club house is now being constructed, and will be ready for occupancy the latter part of August. This house as planned, to quote from the prospectus, "will comprise departments to aid in educating beginners in the interesting study of electricity, in developing the science, and increasing electrical sociability. A course of free lectures in the assembly rooms is being favorably considered; also complete laboratory, electrical library, rooms for out of town visitors, etc., in fact, the construction of an edifice that will comprise comprehensive electrical headquarters where representatives of all electrical interests can assemble and be at home." The club was organized a little over a year ago, with a membership of about fourteen, and now numbers over four hundred. The officers are: President, Henry C. Davis; vice-presidents, Geo. W. Hebard, John B. Powell, Thomas A. Edison, Geo. L. Beetle; secretary, Chas. W. Price; treasurer, Andrew J. Dam; Board of Managers, Henry D. Stanley, M. W. Goodyear, E. T. Gilliland, Willard L. Candee, Chas. Dalton, Cyrus O. Baker, jr., H. B. Thayer, E. T. Lynch jr., Thomas L. Fowler, Henry A. Reed, Fred A. Gilbert, Geo. B. Coggishall. During the summer months the club held their monthly meeting and dinner at the Hotel Brighton, Coney Island. About fifty members were present at the last dinner on the 21st inst., and were entertained afterwards by a paper read by Lieut. P. W. Tappan, U. S. N., on "Recent scientific discoveries relating to the effects of magnetism on watches and marine chronometers." At the preceding meeting Dr. Otto A. Moses presented a paper on "The electric seismometer"—an instrument for indicating the approach and direction of earthquake waves.

Both the elevated and surface railroads have been turning longing eyes toward electricity as a substitute for their present motive power. Numerous experiments have been made with various kinds of motors and batteries, and some

of them have been apparently quite successful, but no road yet has dared make a change. A short time ago an ordinary car moved by a storage battery passed repeatedly over the Fourth avenue surface road. According to reports, the experiment was entirely successful, the car moving at times twelve and fifteen miles an hour. It was easily controlled and stops were made with greater precision than is attained when horses are used. It is probable that before the end of the year there will be one electric railway in this city in practical operation. Ground was broken a few days ago on Fulton street, by the North & East River Railroad company, for an electric railway running from river to river. The Bentley-Knight conduit system will be used. The Jersey City & Bergen Railroad are also soon to move their cars by electricity. They will use a storage battery system invented by Joseph Weiss of Jersey City.

Mayor Hewitt is a member of the Board of Electrical Control, and takes a keen interest in the work. At a recent meeting a resolution was passed providing for the appointment of a chief inspector at $250 a month. The mayor has been putting the candidate for this position through a kind of civil service examination. He holds the absurd (?) idea that a chief inspector ought to have some qualifications for the place, and ought to be able to inspect. The nominee is Charles G. Cornell, who was at one time street commissioner, but has retired from politics since the Tweed days.

This city was visited by two severe thunder storms last Sunday. Much damage was done by the storm, and many buildings were struck by lightning. In view of the damage done by lightning throughout the country during the past week, the following clipping seems *apropos:*—"Notwithstanding the probable fact that there is no 'electric fluid,' and the known fact that electricity does not 'travel,' but is merely molecular change, and that consequently thunderbolts never hit anybody, and lightning rods only 'lower the potential,' people are getting struck by lightning, and the 'electrical fluid' is running up and down steeples all over the country."

A. C. White, superintendent of the Providence Telephone company, has been in the city this week, discussing the details of a multiple switchboard that is to be put in the Providence exchange during the present year. This board is to be of the latest pattern, known as the single cord system. Orders have been placed for this same style of board by the New York & New Jersey Telephone company for the Brooklyn exchange, and by the Bell Telephone company of Buffalo for the Buffalo exchange.

The new building of the Metropolitan Telegraph & Telephone company is nearly completed, and the following officers of the company have taken possession of their new quarters: General Huidekoper, vice-president and general manager; J. H. Cahill, secretary; A. S. Dodd, treasurer, and the auditing and purchasing departments.

At the meeting of the railway telegraph superintendents in Boston last week, considerable attention was given to the question of substituting a new telegraphic symbol to replace the long dash used for the zero in the Morse alphabet. So much trouble and confusion has been occasioned by mistaking the short dash, which is the Morse symbol for the letter L, for the long dash, which is the symbol for the cipher, that a committee was appointed a year ago to consider the question of making a change. The chairman of the committee, in making his report, said that he recognized the desirability of some change, but had nothing to suggest. After a lengthy discussion, the matter was referred back to the committee for further consideration.

The underground work in New York and Brooklyn was inspected last week by a number of Boston officials. They were sent out by that city to investigate underground work, and will visit Philadelphia, Washington and other cities.

S.

The Detroit Budget.

DETROIT, MICH., July 23.—Representatives of commerce to the estimated amount of $200,000,000 attended the National Waterways convention at Sault Ste. Marie, last week. Delegates, 400 in number, representing the boards of trade in New York, Buffalo, Cleveland, Chicago, Duluth, and other large points, as well as every state in any way interested in inter-lake commerce, were present. There was also present a distinguished assemblage of senators and congressmen. Congress will be asked to appropriate $7,000,000 for the Sault ship canal and the improving of Hay Lake channel.

The Sault Ste. Marie Electric Light & Power Co. has been granted a franchise running for twenty years Work has already commenced. The officers are: President, John C. Spry; vice-president, E. M. Lacy; secretary, W. C. Teter; general manager, C. M. Wilson.

Jackson, Mich., will use the Edison system.

A $19,000 addition to the mechanical laboratory at the university of Michigan, has been begun.

The Grand Rapids Electric Light & Fuel Company organized on the 21st inst. At a preliminary meeting of the stockholders, held on Friday, contracts were let for furnishing the engines, boilers, belts, etc. Several eastern and western houses were represented; Chicago very prominently—but Marr & Co., Columbus, Ohio, secured the work. This company will sublet the boiler and belt contracts to Grand Rapids firms. The Edison system will be used, and it is expected that 5,000 lights will be in operation by November 1st. Stock to the amount of $200,000 was taken. The cost of putting in of the system will be about $125,000.

The Joseph Turner & Sons' Manufacturing Co, late of Kent, Ohio, will erect a building 200 ft.x64 ft., four stories high, at Detroit. They manufacture fine mohair goods, and employ from 1,200 to 1,500 workmen.

Two new cars, built by the Pullman Co., have been added to the Highland Park Electric railway system. They are a marked improvement over the old style cars, the motors being placed on the front platform entirely out of the way of passengers. C.

From Indianapolis.

INDIANAPOLIS, July 24.—The Attica, Ind., Electric Light, Heat & Power company, with a capital of $15,000 has been incorporated. That city already has a large Edison incandescent plant furnishing light to business houses, offices, and private dwellings.

Goshen and Elkhart, Ind., have invested in a fire alarm service.

Laporte, Ind., has adopted the Cushman telephone system. Michigan City stands alone in the northern part of the state in the adoption of the toll system required by the Bell company.

"The following comes from LaFayette, Ind., *Journal:* About 5 o'clock yesterday afternoon Mrs. J. M. S. White was kneeling at an up-stairs window with a pearl-handled penknife clasped in one hand, the point resting in the palm of the other. A flash of lightning, the solitary flash that thrilled the populace with a premonition of rain, struck the knife blade and broke it in two. The current then passed to Mrs. White's arm and down her right side. For several days she had been suffering with severe pains in her side, but when she recovered from the electric shock she found the pain had disappeared. The lightning did no damage beyond breaking the knife."

Your correspondent heard a statement of a lady of Paris, Ill., a few days ago, that since the city had adopted electric lamps for street lighting, the houses were free from bugs and insects that gather around a light during warm summer evenings, the electric lamp being the greater attraction. M.

From the Pacific Slope.

SAN FRANCISCO, July 16.—Brainard Rorison, superintendent and manager of the Jenney Electric Co., left this morning for home on the steamer Columbia. This steamer is said to be the first steamer in the United States lighted by incandescent light. The plant consists of three Edison dynamos and one exciter.

The Electric Improvement Co. have opened an office at 217 Sansome street, this city. The company is composed of well-known capitalists and engineers. It will push electric railways, lighting and transmission of power.

Gas inspector McCarty of this city refused to audit the bill for electric lighting of the suburbs of this city, as he claimed that the California Electric Light Co. reduced the size of the carbons used from 5/8 to 1/2 inch, thereby reducing the candle power of the lamps, while the city pays for 4,000 candle power lamps. At the meeting of the light committee George Roe, secretary and manager of the company, introduced electricians in his behalf; the committee ordered the bill audited, and Inspector McCarty's charge was not sustained.

The Pacific Coast Electric Construction Co. have removed from this city to Oakland Cal., where they will run a power and light station in connection with their works.

F. R. Holt of Visalia, Cal., who is largely interested in electric lighting, has left for the east in connection with electric matters.

There is some talk of starting an Electric club in San Francisco.

Personal Paragraphs.

W. W. Smith, general superintendent, and C. W. McDaniel, superintendent of the Missouri & Kansas Telephone Co., were among the callers at the WESTERN ELECTRICIAN office in the early part of the week.

On recommendation of Prof. Anthony, who has recently vacated the chair of electrical engineering in Cornell university, Prof. Nichols of Kansas has been elected to fill the vacancy.

Telephone Stock Quotations

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	385	400
Central Union	45	46
Michigan	76	77
Great Southern	30	33
Colorado	20	22
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27

NEW ENTERPRISES.

Castle & Co. are erecting at Quincy, Ill., a building for the manufacture of stoves.

Three school houses are to be built at Summit Grove, Ind.

At Austin, Minn., Anton Friederich is building a store to cost $4,000.

A building for the accommodation of the Y. M. C. A. at Council Bluffs, Iowa, is to be built this summer. The estimated cost is $20,000, and the architect is William Ward of Council Bluffs.

The proprietors of the Grand Hotel at Cedar Rapids, Ia., will lay out $30,000 in improvements.

A new school house, to cost $17,000, is to be built in La Crosse, Wis.

The Chicago, Madison & Northern railroad company will build a passenger station, freight depot, and round house at Madison, Wis.

The Presbyterian society at Kansas City, Mo., is building a new church at a cost of $40,000.

Samuel Boles, of Kansas City, Mo., is building a $9,000 residence, modern in all respects. J. T. Cappels of the same place is building a residence that will cost a like amount.

The Iowa savings bank of Sioux City, Iowa, will erect a handsome bank building at a cost of $35,000.

At Sterling, Kan., the city has voted $12,000 for the erection of a school house.

The Methodist Episcopal Society of Danville, Ill., will erect a church to cost $35,000.

At Louisiana, Mo., Estes & Patrick are erecting a $25,000 flour mill.

The Besley Brewing Co. of Waukegan, Ill., are making extensive alterations, involving an expenditure of at least $25,000.

At Kansas City, Mo., the Grace Episcopal church is erecting a new edifice that will cost $20,000.

At Larned, Kan., a new school house to cost $40,000 is being built.

J. C. Nutting of Northfield Minn., is erecting a residence at a cost of $10,000. E. Holland, of the same place, is putting up a three-story block at a cost of $15,000.

A new electric light plant has been established in Coffeyville, Kan. M. Upham, Geo. Slosson, W. McCoy and others are interested. About $10,000 will be expended on the plant.

J. A. Trost, of Garfield avenue, Kansas City, Mo., is building a $15,000 residence. It will be fitted with electric appliances.

A new church for the First Baptist Society of Aurora, Ill, is to be built at a cost of $20,000.

About $20,000 in improvements is to be expended on T. M. James' store at Kansas City, Mo.

A new chair factory to cost $100,000, is to be built at Findlay, O., by Moores Chair Works.

M. F. Wolfe, of Chicago, is building a $30,000 malt house at Cedar Rapids, Ia.

O. C. Dewey, of Wheeling, W. Va., and A. L. Wetherill, Massillon, O., are interested in a new steel nail works to be erected at Findlay, O. The Withington Co. are erecting new steel works, estimated cost $15,000, at the same place.

The Independent Order of Odd Fellows are putting up stores and an assembly hall at Duluth, Minn. About $20,000 will be expended.

THE ELECTRIC MOTOR.

The select committee of the house of commons appointed to deal with the application of the West Metropolitan tramways in London to use electrical or other mechanical power on their lines, have decided to pass the bill, in spite of the opposition of the Metropolitan board of works, which held that the provisional order which the bill confirms ought not to proceed without the consent of the local authorities.

At Rochester, N. Y., a triangular fight is going on between the street car company which has enjoyed exclusive privileges for a quarter of a century or more, a cable company and the Rochester Electrical company for a valuable franchise in the way of a right to run street cars on certain streets under their respective systems. By the terms of a recent law in New York state such franchises are to be auctioned off to the highest bidder. Recently, in that city, the bid of the street car company was one-twentieth of one per cent., there practically being no other bidder. The cable company, and the electrical company, both recent organizations, have entered the field to win, however, and the outcome of the fight will be watched with interest.

THE ELECTRIC LIGHT.

San Antonio, Tex., is considering propositions to light the city by electricity.

The Economic Electric Light & Gas Co., the Hyde Park Electric Light Co., and the Armour & Poole Electric Light Co., are all working to secure the franchise from the board of trustees of Hyde Park, Ill., enabling them to light the place by the electric light. It is said that a condition precedent to the granting of the franchise will be that all wires must go underground.

For the Oerlikon dynamo now on exhibition in the machinery court of the Liverpool exhibition an electrical efficiency of 98 per cent. and a commercial efficiency of 95 per cent. is claimed.

Among the recently incorporated companies is the Mount Vernon Electric Light & Power company, at Mount Vernon, Ill; capital stock, $10,000; to light the city of Mount Vernon with electricity and to furnish power for other purpose; incorporators, Allen C. Tanner, George W. Evans, Morris Emmerson, and others.

The municipality of Leon, Spain, offers a monopoly of fifty years for lighting the town with 260 glow lamps of 20 c.p., burning each on an average 2,200 hours per annum, for the sum of £720. The contractor will be the only person allowed to fix cables or wires for the purpose of electric lighting, whether for public or private lights. No price is stipulated for private lighting. Tenders, which will be opened on the 6th August, are to be on the basis of a diminution of the number of years of the monopoly. Besides the lighting of the streets, the municipal offices are to be lighted by glow lamps of 20 c.p., to be paid for at the rate of about 4 pence per hour. The total numbers of lights likely to be used, including the theatre and private houses, will not exceed 600, but a price of 6d. per lamp hour would probably be obtainable.

THE TELEPHONE.

The Missouri & Kansas Telephone Co. now has 2,200 subscribers in Kansas City. During the month the company has put up 155 telephones.

A dispatch from St. Paul states that trouble is said to be brewing between the Bell Telephone company and the Erie Telephone & Telegraph company, which conducts the exchanges in Minneapolis, St. Paul and neighboring towns. Originally the right to use telephones in Minneapolis and St. Paul was obtained by R. H. Hankinson, John Watson, F. B. Jillson and Morris Towne, the franchise granted by the Bell company being for eight years. Several years ago the Hankinson-Watson combination disposed of its interest to the Erie Telephone company for $300,000. The contract between the Bell and Hankinson-Watson companies expired June 1st last. The Bell company now claims that a new contract for eight years must be made with it by the Erie people at the rate of 30 per cent. of the earnings for eight years, which is estimated by well-informed parties at $200,000. The Bell company further claim that the contract in regard to the exchanges has been violated. Attorneys who have examined the matter claim that the Erie company is without remedy and will be forced to submit.

A remarkable increase has taken place in the number of telegraphic messages forwarded by telephone between the postoffices and private establishments, says the Brussels correspondent of *Industries*. The number during the first five months of this year on the Brussels, Antwerp, Liége, Charleroi, Ghent, Verviers, and Louvaise lines was 167,838, as against 122,682 during the corresponding period of 1886, an increase of 37 per cent. On seven more recently established lines, the number of such messages this year was 13,418. This gives a total of 181,286, or about 1,200 per day.

Judge Wallace, in the United States circuit court, in New York, July 21st, gave a decision in the case of the American Bell Telephone company against the Globe Telephone company, to restrain the defendant from infringing on the patent granted to Alexander Graham Bell on March 7th, 1876. Judge Wallace granted the permanent injunction asked for by the Bell Telephone company.

Corporation-counsel Green, of Chicago, has asked the committee on license to give him more time in which to investigate the legality of Alderman Hamline's proposed telephone ordinance. The ordinance confers upon the Bell Telephone company certain absolute rights, and it is now an exceedingly difficult task to frame an ordinance imposing a license tax upon the company which will stand in the courts.

Monday of this week an electric light wire fell across a maze of telephone wires belonging to the Chicago Telephone company, and burned them off. Lightning arresters saved the instruments from destruction.

The service between Brussels and Paris, which hitherto has been limited to messages passing between the two exchanges, is about to be connected with the private telephones of subscribers in Brussels. No change will be necessary in the Bell-Blake instruments actually in use, but considerable alterations are required in the switch boards and connections of the Brussels central telephone station. It is also probable that the present single circuits of subscribers will be found insufficient on account of self induction, and to overcome this difficulty the telephone company will fix a return wire between the exchange and subscribers for an additional annual rental of £4 if the distance does not exceed two miles, £5 up to two and a half miles, and £6 up to three miles.

THE TELEGRAPH.

The Bay State Telegraph company is building a line of ten wires connecting New York and Boston.

Daniel Davis of Princeton, Mass., who made much of the earliest machinery for Professor Morse of telegraph fame, recently died.

A new bidder for the Baltimore & Ohio telegraph system has been brought to the surface in New York—the Brotherhood of Telegraphers of the United States. It is asserted that representatives of the fraternity have offered $3,000,000 for the plant, $500,000 cash on the acceptance of the offer and the remaining $2,500,000 at the end of six months.

The Telegraphers' Investment company, which has been organized at Washington, D. C., for the purpose of dealing in real estate, has elected the following board of managers and officers: Managers, M. Marean, manager Western Union company, Wm. H. Young, night manager Western Union, Jas H. King, cashier Western Union, E. L. Bugbee, Geo. W. Kern, Andrew G. Johnson, Louis M. Smith, Lester S. Fisher and John A. Hutchison; officers, Wm. H. Young, president; J. A. Hutchison, vice-president; Elijah L. Bugbee, secretary; Jas. H. King, treasurer; Geo. W. Kern, attorney.

About 17,000 feet of underground cable has just been laid in Washington, D. C.

Miscellaneous Notes.

The Thomson-Houston Electric company are rapidly perfecting their plans for the manufacture of carbons. The rupture of the carbon combination has not changed their original intention in this respect.

Execution by electricity has been adopted by Buffalo, N. Y., the victims, however, being dogs. The doomed canines are put one by one in a box lined with tin and having about an inch of water in the bottom. A wire is then introduced into the mouth of the dog the current is turned on and the dog is ready for immediate interment.

Business Mention.

The Western Electric Co., of Chicago, have just received an order for a multiple switch board for St. Petersburg, Russia; equipment, 1,200; capacity, 6,000 lines. Their cable department is very busy. They have orders for 2,000 miles of conductors in Patterson cables. The Chicago Arc Light & Power Co. have placed an order for several miles of cable and the Lincoln Park commissioners of Chicago are putting their electric light circuit underground in Patterson cables. The extensive grounds of the Illinois Eastern Hospital for the Insane, at Kankakee, Ill., are to be lighted by a Western Electric Co. arc light plant of fifty lights.

Work has been begun on the addition to the building of the Western Electric Co. in Chicago.

The India Rubber and Gutta Percha Insulating Co., W. M. Habirshaw, general manager, 159 Front street, New York, has recently issued very neat and useful price lists showing specimens of electric light leads, soft copper, stranded, and giving prices per foot. The information given on the lists is complete and exhaustive.

The catalogue of the Cleveland Electrical Manfg. Co., just received, shows their apparatus styled the American watchman's time detector. By the use of this system the story is told every morning whether the night watchman attended to his duty or whether he shirked it. The record can not be tampered with and therefore is infallible.

The Thomson-Houston Electric company have recently received orders increasing the arc light plant of the Oakland Gas Co., Oakland, Cal., by fifty lights; of the Battle Creek, Mich., plant fifty lights; of the Houghton, Mich., plant thirty lights. The company has also taken an order for a plant of eighteen arc lights of the People's Gas Co. at Canton, Ill.

The Missouri & Kansas Telephone Co. in the first part of the week placed an order with the Western Electric Co., of Chicago, for two sections of multiple switch-board, extending their present Kansas City system. The company also placed orders for multiple switch-boards for their exchanges at St. Joseph and Topeka. Business in their territory is good and growing. The Western Electric company has also taken an order for an additional section of multiple switch-board for Omaha, Neb.

Electrical Patents.

Issued July 18, 1887.

366,654. Electric Bell-Coupler for Steam Railroads. Joseph M. Duby, Medford, and Joseph L. Edmester, Chelsea, Mass. When two cars are separated so as to tear apart the

two members of the electric coupler between them, the circuit is momentarily opened and the alarm mechanism tripped and set in motion. By means of a push key the circuit is held closed, while the two members are being coupled together or uncoupled.

366,660. Electric Boot-Blacking Apparatus. Henry R. Gardner, Boston, Mass. The brush is driven by an electric motor placed in a case under the foot rest.

366,673. Device for Holding Incandescent-Lamp Filaments while the same are being Flashed. Herman Lemp and Merle J. Wightman, Hartford, Conn.

366,695. Quadruplex Telegraphy. Gerritt Smith, Astoria, N. Y. The armature lever of the local sounder, which is operated by the neutral relay, forms a part of the condenser circuit. When this lever rests against its back stop the condenser circuit is closed, and when resting against its front stop the condenser circuit is open. By this automatic circuit breaker currents from the condenser are prevented from operating the relay, except when required to bridge over reversals.

366,717. Inclosing-Cell for Electric Batteries. Camille A. Faure, New York, N. Y.

366,777. Voltaic Belt. Charles B. Judd, Council Bluffs, Iowa.

366,811. Combined Street-Railway and Conduit. Gilbert C. Bolgiano, Baltimore, Md. The stringers under the rails are hollow or trough shaped, and the rails seated directly upon the vertical walls of the trough cover the cables laid therein.

366,824. Apparatus for Measuring Electricity. George Forbes, County of Middlesex, England. The current to be measured is sent through a metallic ribbon which being heated heats the surrounding air or other medium. The air currents thus set in motion strike directly against an anemometer.

366,938. Electric-Arc Light. Stephen Donbrava, Prague, Bohemia, Austria-Hungary. Solenoids which regulate the length of the arc are placed in the neutral wire of a Wheatstone balance. Variations in the resistance of the arc from the normal sends current through the solenoids in the proper direction to bring the arc to its normal length and resistance.

366,941. Dynamo-Electric Machine. James W. Easton, New York, N. Y. The end plates of the machine are formed partly of cast iron and partly of wrought iron. The plates thus formed, it is claimed, possess the double advantage of being capable of more powerful magnetization, and of retaining their polarization during long periods of disuse.

366,970. Telegraph Instrument. William A. Melbourne, Swanwick, Ill. By means of a slide or switch two independent main lines may be separately connected with the same sounder, key and relay.

366,994. Attachment for Telephones. Thomas C. Bradford, Cincinnati, Ohio. This is an ear attachment made in a single piece preferably of rubber. The cylindrical portion is stretched over the head of the telephone like a nipple over the neck of a bottle. The outer end is flaring so as to fit over the ear.

367,002. Electric Lamp. Charles A. Homans, Winchester, Mass.

367,003. Ear-Piece for Telephones. George A. Huewe, Cincinnati, Ohio.

367,004. Ear-Piece for Telephones. George A. Huewe, Cincinnati, Ohio.

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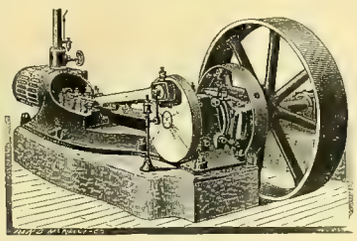

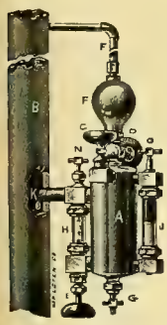

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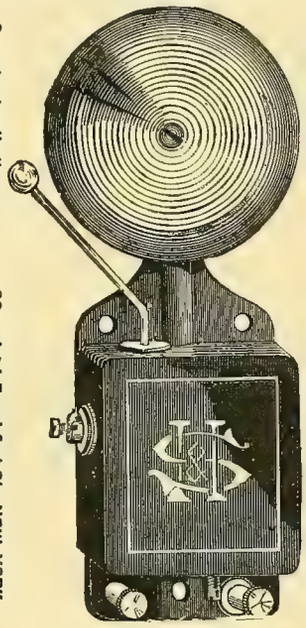

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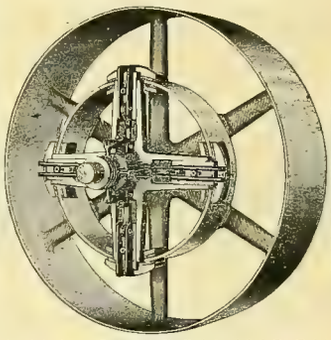

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The Sprague Motors have been formally adopted for use on the Edison Circuits, and they are being introduced on these and also on Westinghouse, Brush-Swan, Thomson-Houston and United States Circuits, in New York, Chicago, Boston, Des Moines, Elgin, Oskaloosa, Pittsburgh, Chester, Williamsport, Lancaster, Shamokin, York, Detroit, Topeka, Cincinnati, Springfield, New Brunswick, Fall River, New Bedford, Milford, Taunton, Lawrence, Woonsocket, Fort Meyer, Waterbury, Annapolis, St. Louis, Abilene, Pawtucket, Syracuse, Canada, and the Argentine Republic, and have been shipped to Berlin and Milan.

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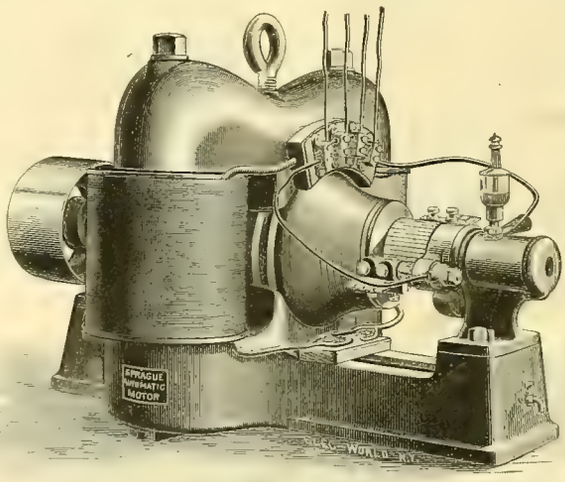
At present there are being operated in Boston seventy-five motors, varying from 1-2 to 25 horse-power.

This is the only company in the United States devoting its entire energies to the different questions involved in the transmission of power, and it is putting into practical use more motors of and over one-half horse-power than all other companies combined.



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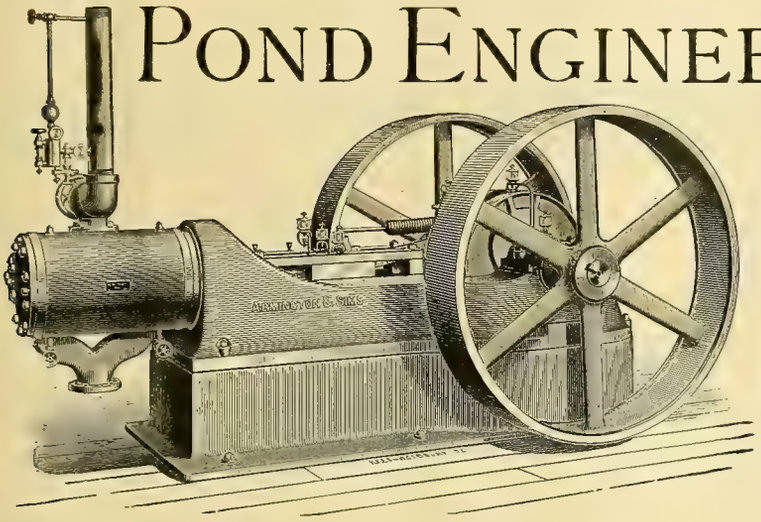

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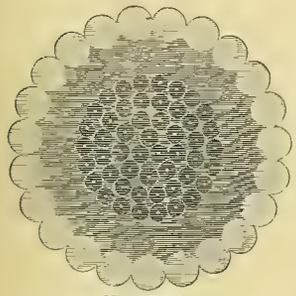

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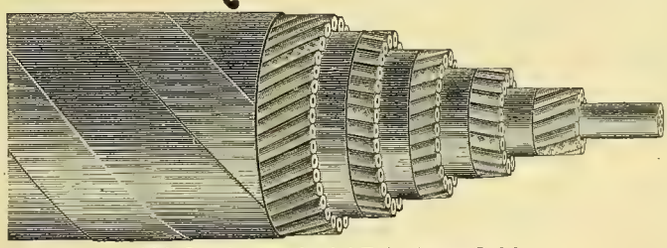

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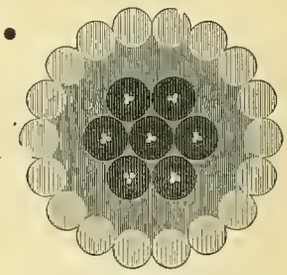

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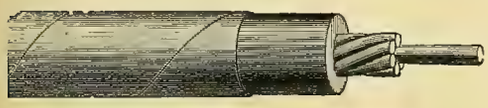

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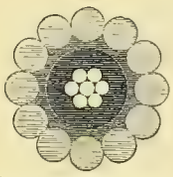

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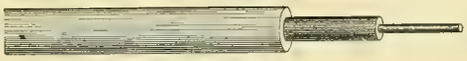

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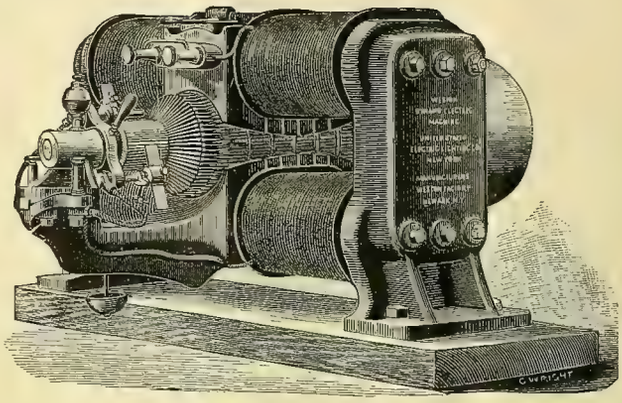

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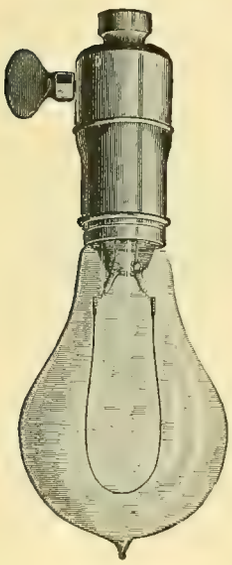

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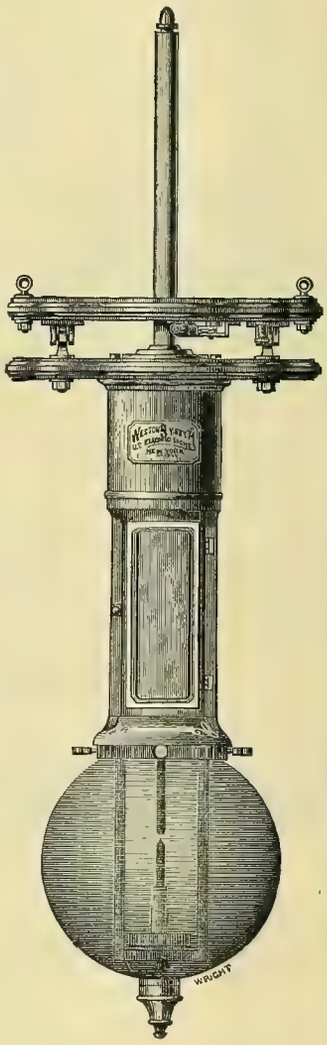

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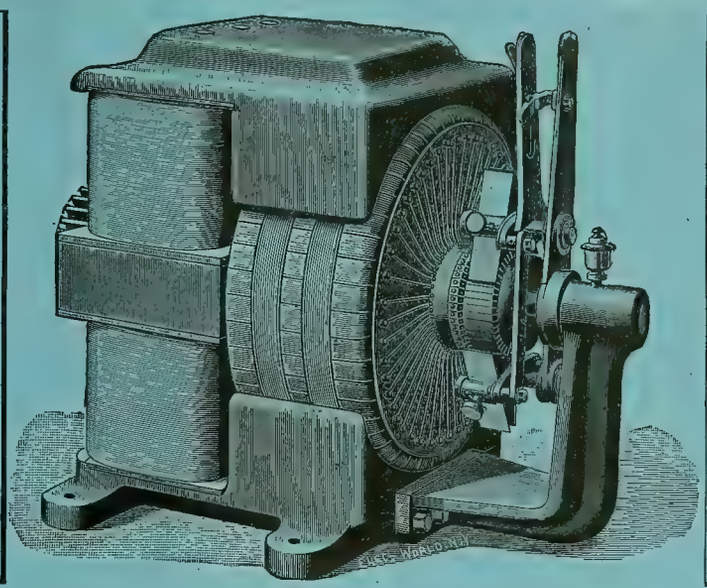

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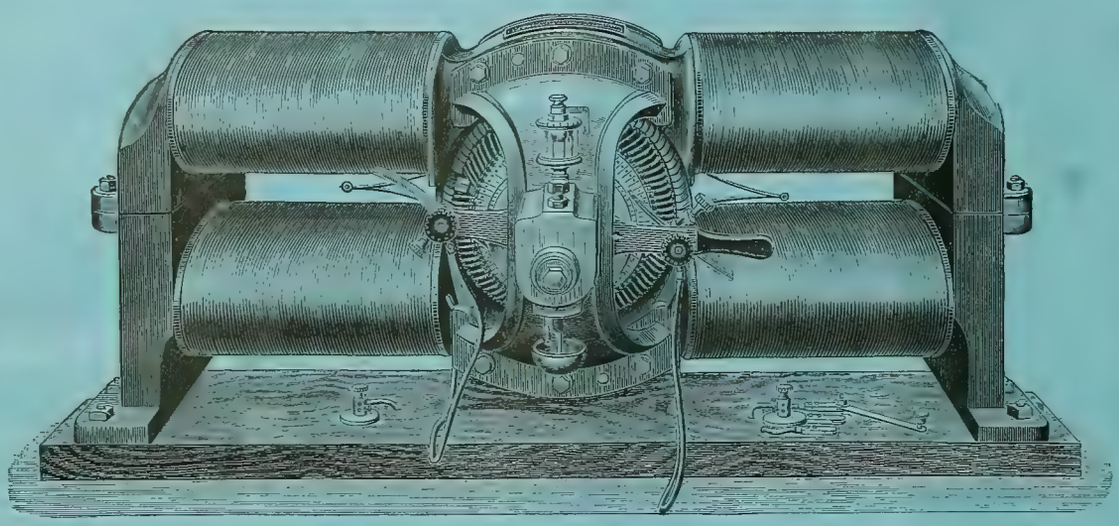

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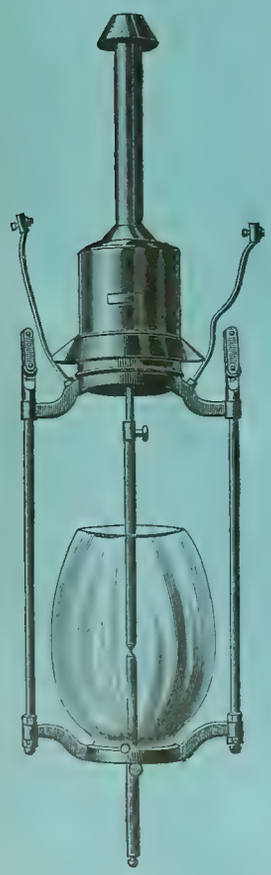
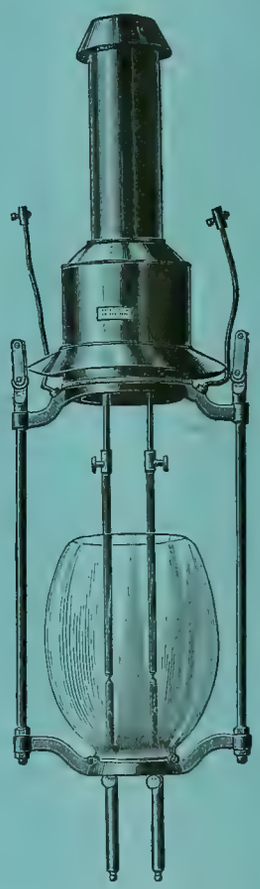
W. J. BUCKLEY, Manager.

J. A. Jenney Dynamo-Electric Machines

AND THE

Perfectly Automatic and Self-Regulating





JENNEY ARC LIGHT

The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

ONLY GOLD MEDAL

At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

This system HAS NO EQUAL for SIMPLICITY, DURABILITY and STRENGTH OF LIGHT.

ALSO

COMPLETE INCANDESCENT SYSTEM.

DYNAMO: PERFECTLY AUTOMATIC, SHUNT WOUND, REQUIRING NO RESISTANCE for variable load.

LAMP: NEW FILAMENT, NEW PRINCIPLE of Construction, REMARKABLE LENGTH OF LIFE with FULL CANDLE POWER, will not deposit carbon on inner surface of bulb.

The filament is as pliable as a piece of thread and is not made brittle by the action of the current.

Complete System of Fixtures and Attachments, also full line of Electroliers, Combination Fixtures and Shades.

We are in the market for Large Incandescent Contracts.

ELECTRIC MOTORS

We have the Only Perfect Working Headlight for Steamboats, with Focusing Reflector. Full information furnished on application.

Philadelphia Office: 26 North Seventh Street. G. A. WILBUR, Manager.

Western Electrician.

EVERY SATURDAY.

Vol. I. CHICAGO, AUGUST 6, 1887. No. 6.

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Reels of 180 lbs.

Electric Light Supplies.

LINE WIRE,

Special attention given to durability of insulation and smooth, hard finish.

THE ELECTRICAL SUPPLY CO.

171 Randolph Street, CHICAGO.

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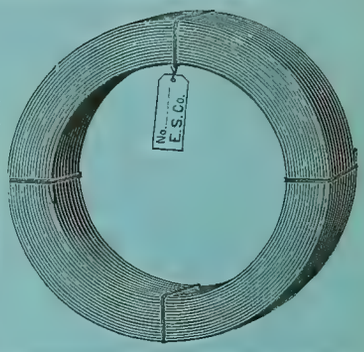
Coils of 150 lbs.



NEW ❋ YORK ❋ SAFETY ❋ STEAM ❋ POWER ❋ CO.

BUILDERS OF HIGH GRADE SELF-CONTAINED

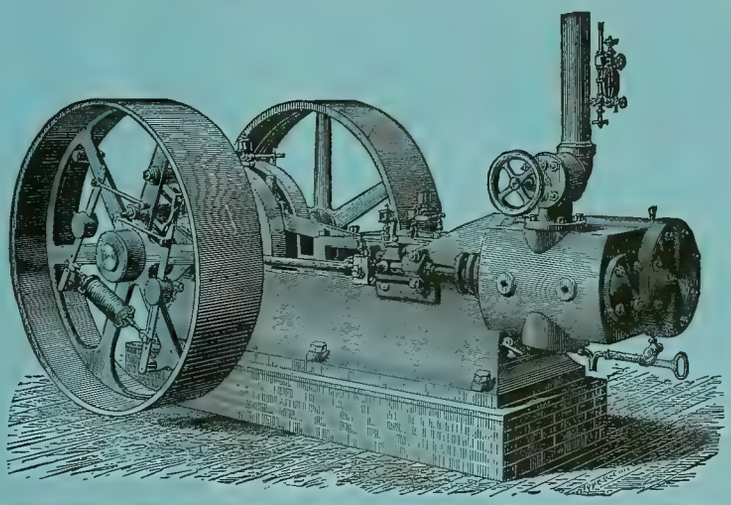
AUTOMATIC

Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC ❋ LIGHTS

And other duty requiring close regulation of speed.



ADVANTAGES:

Great strength without excessive weight,
Small space required.
Simplicity of construction.
Accessibility of all parts.

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CHARLES D. JENNEY, Electrician.

BRAINARD RORISON, Secretary.
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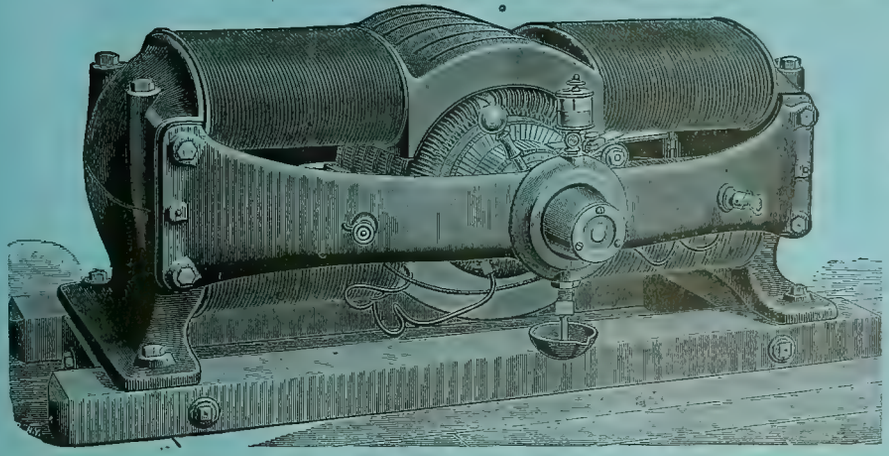
JENNEY ELECTRIC COMPANY,

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp ❋ Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

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OFFICE AND WORKS:

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The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

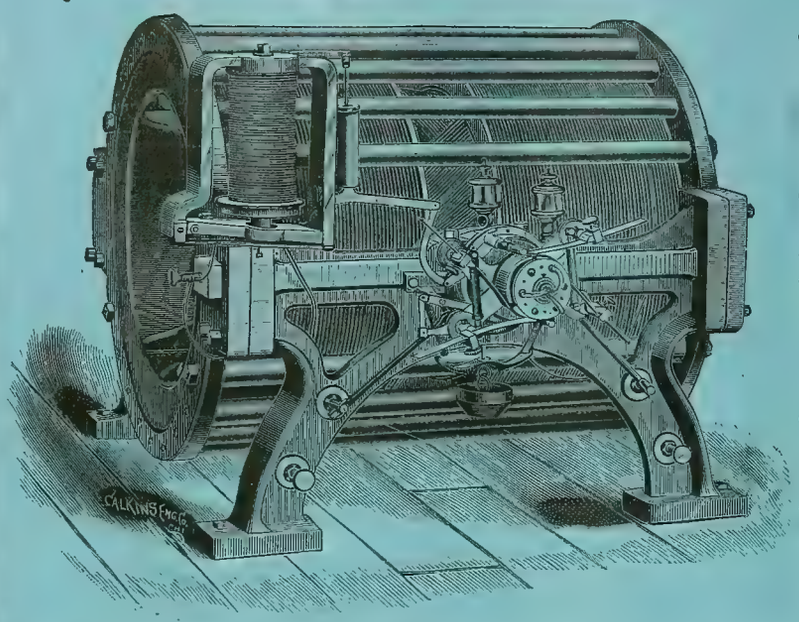
OF

Electric Arc-Lighting

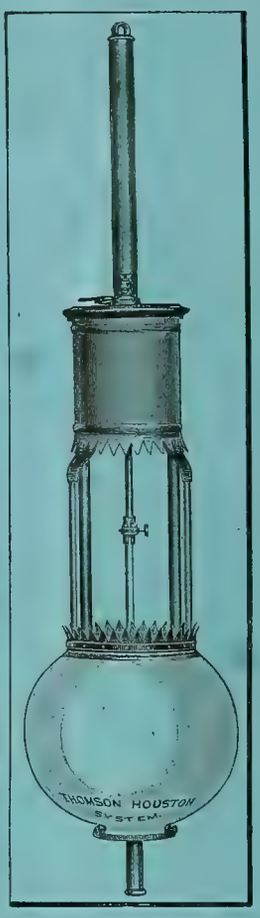
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

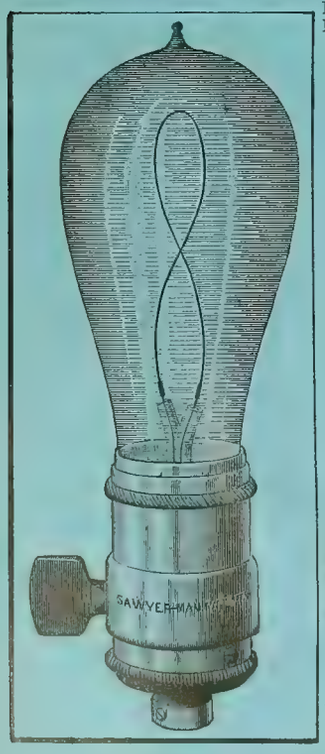


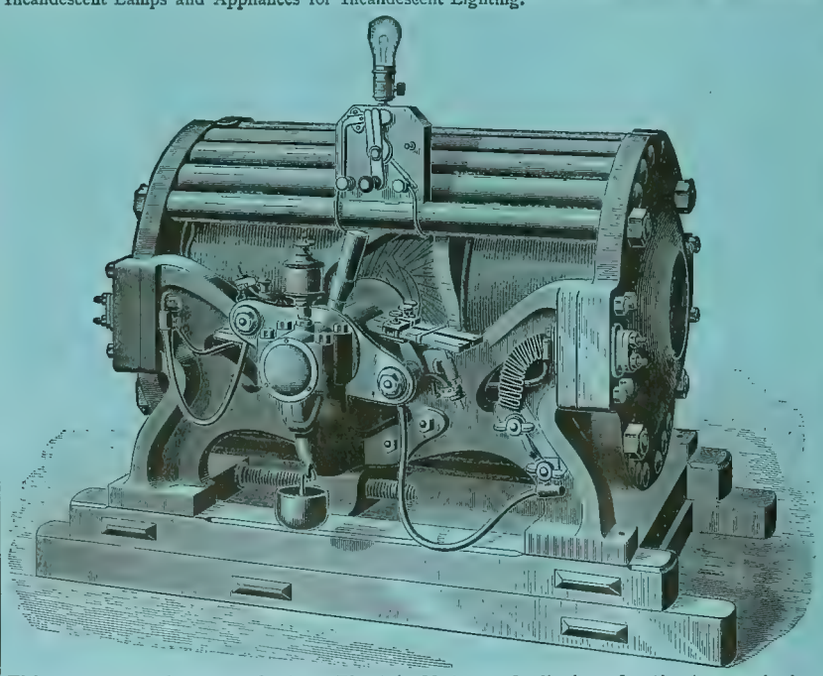
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT **LONG DISTANCE INCANDESCENT LIGHTING.**

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

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AMERICAN SYSTEM

OF

ELECTRIC LIGHTING

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufg. Co.

18 Cortlandt Street, NEW YORK.

For Simplicity of Construction, Steadiness and Purity of Light, Perfection of Automatic Regulation, Economy of Power in Operation, Freedom from getting out of Order, and Absolute Safety of Armatures from Burning,

THE AMERICAN DYNAMO HAS NO EQUAL

INTENDING PURCHASERS,

Whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

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AMERICAN ELECTRIC MANUFACTURING CO.,

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REYNOLDS' IMPROVED CORLISS.

THE IDEAL ENGINE FOR ELECTRIC LIGHT WORK.

Unequaled for Close Regulation

—AND—

ECONOMY OF FUEL.

Write for our Catalogue and Circular giving List of Users.

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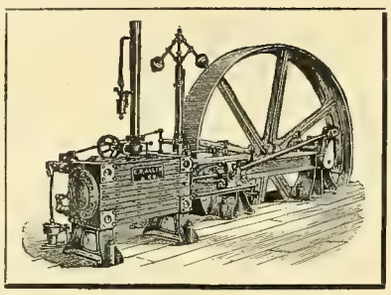

We refer to the following electric light plants now using the Reynolds' Corliss:
Brush Electric Light and Power Co., Cleveland, O.
Edison Electric Light and Power Co., Rockford, Ill.
Syracuse Electric Light Co., Syracuse, N. Y.
Louisiana Electric Light and Power Co., New Orleans, La., three engines
Badger Illuminating Co., Milwaukee, Wis., two engines.
West Side Power Co., Minneapolis, Minn., four engines
Louisville Electric Light Co., Louisville, Ky.
La Crosse Brush Electric Light and Power Co., La Crosse, Wis.
C., M. & St. P. R. R., Milwaukee, Wis.
Menominee Mining Co., Iron Mountain, Mich.
West Hotel, Minneapolis, Minn.
Plankinton House, Milwaukee, Wis.
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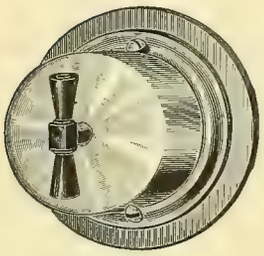
J. V. Farwell & Co., Chicago, Ill.
Chas. H. Slack, Chicago, Ill.
Mandel Brothers, Chicago, Ill.
C. Boetcher, Leadville, Col.
Omaha Thomson-Houston Electric Light Co., Omaha, Neb.
Thomson-Houston Electric Co., Racine, Wis.
Sioux Falls Electric Light and Power Co., Sioux Falls, Dakota.
Electric and Water Supply Co., Neillsville, Wis

EDW. P. ALLIS & CO., RELIANCE WORKS, MILWAUKEE, WIS.

CHICAGO BRANCH: 48 South Canal Street.

FOREST CITY ELECTRIC WORKS,

MANUFACTURERS OF



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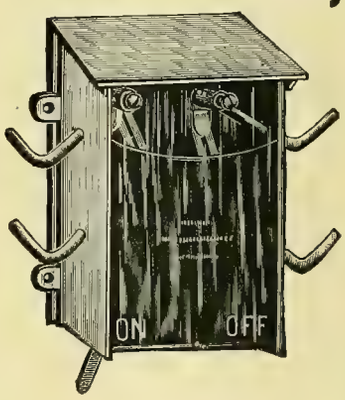
GANG SWITCHES, FROM 5 TO 40 AMPORES.

Quick Make and Break Uncontrolled by the Handle.

Correspondence Solicited with Electric Light Companies.



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FARADAY CARBON COMPANY, LIMITED

CAPACITY, 1,000,000 CARBONS MONTHLY.

QUALITY GUARANTEED EQUAL TO ANY IN THE MARKET.

LOW PRICE, LIBERAL DISCOUNT ON LARGE ORDERS. CORRESPONDENCE SOLICITED.

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DEALERS IN

ELECTRICAL SUPPLIES

FOR THE TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT.

Hotel and House Annunciators, Burglar Alarms, Fire Alarms, Electric Gas Lighting, Speaking Tubes, Elevator Annunciators, Batteries, Push Buttons, Electric Pens, Telegraph Learner's Instruments, Medical Batteries, Linemen's Tools, Bell Hanger's Supplies, Railway Velocipede Cars, Etc.

WESTERN AGENTS,—THE OKONITE CO., and the Return-Call System of Hotel Annunciators. Fire alarms for cities and towns.

We own the Franchises of the Western States and Territories, for the Improved **McCULLOH AMERICAN DISTRICT TELEGRAPH SYSTEM** and are prepared to give franchises and construct plants on reasonable terms.

☞ Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. **Illustrated Catalogue and Price List on Application.**

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16 Broad Street, New York.

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65 Fifth Ave., New York.

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GENEVA ✦ NON-MAGNETIC ✦ WATCHES.

THE ONLY WATCHES MADE CONTAINING

Paillard's Patent Non-Magnetic Inoxydable Compensation Balance and Hair Spring,

WHICH ARE

UNINFLUENCED BY MAGNETISM OR ELECTRICITY

AND WHICH ARE ADJUSTED TO TEMPERATURE.

These Non-Magnetic Qualities are in the Movement (or Works) and Require No Shield or Other Protection.

Especially adapted to the use of employes of Electric Light and Telephone Companies, Engineers, Conductors, and all whose business calls them among the multiplicity of Electrical Devices.

ASK YOUR JEWELER TO SHOW THEM TO YOU.

GENEVA NON-MAGNETIC WATCH CO., Limited, General Offices, 177 and 179 Broadway, New York.

Send for Catalogue and mention this paper.

The Parker-Russell Mining and Mfg. Co.

Electric Light Carbons

ADAPTED TO ALL SYSTEMS.

CITY OFFICE: 711 PINE STREET, ST. LOUIS, MO.

Heisler ✦ Electric ✦ Light ✦ Company,

809 to 817 SOUTH 7th STREET, ST. LOUIS, MO.

MANUFACTURERS AND PATENTEES OF THE

Long Distance Incandescent Electric Light System,

CONTRACTORS FOR CENTRAL STATION PLANTS,

Call the attention of Arc Light Companies, Gas Companies, Municipal Authorities (particularly in towns without a Gas Plant) and parties having Steam and Water Power to the superior advantages of this system.

Combining Successfully the Illumination of the Streets with the universal supply of Incandescent Light to every Private House,

suited to comply with all the various demands of Commercial and Domestic life by the **most perfect Automatic Regulation,** with every facility for changing and shifting the circuits or extending the same to any desired distance at very small cost. This system has made **Central Station Lighting a practical success.**

Certain other advantages ensure the economical and profitable running of the Plants. The remarkable financial success that has attended the adoption of the HEISLER SYSTEM evidences this.

A large number of towns have adopted it for **general illumination** in lieu of Gas, circuits of **fifteen** to **twenty miles** and **even more** having been constructed for lighting the streets. IN SOME INSTANCES THE POWER STATION IS LOCATED OVER FIVE MILES FROM THE LAMP DISTRIBUTION.

Reference to the following Companies who have adopted the **HEISLER SYSTEM** is respectfully made and close investigation solicited.

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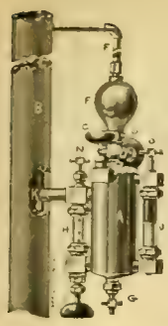
CLEVELAND ELECTRIC LIGHT CO., Cleveland, Ohio.
LEAVENWORTH COAL CO., Leavenworth, Kan.
BRUSH ELECTRIC CO. OF VIRGINIA, Norfolk, Va.
SALT LAKE POWER, LIGHT & HEATING CO., Salt Lake City, Utah.
OGDEN ELECTRIC LIGHT CO., Ogden City, Utah.
PENDLETON ELECTRIC LIGHT CO., Pendleton, Oregon.
MANKATO ELECTRIC LIGHT CO., Mankato, Minn.
MONTICELLO ELECTRIC LIGHT CO., Monticello, Minn.
FERGUS FALLS ELECTRIC LIGHT CO., Fergus Falls, Minn.
MATTEAWAN ELECTRIC LIGHT CO., Matteawan, N. Y.
OTTAWA ELECTRIC LIGHT CO., Ottawa, Kan.
EUGENE ELECTRIC LIGHT CO., Eugene City, Oregon.
LIBERTY ELECTRIC LIGHT CO., Liberty, Mo.
KINGMAN ELECTRIC LIGHT CO., Kingman, Kan.
VINCENNES ELECTRIC LIGHT CO., Vincennes, Ind.
SAINT LOUIS ILLUMINATING CO., St. Louis, Mo.
Etc., Etc., Etc.



The Detroit Sight Feed Lubricators

Are pronounced the best by more than 20,000 users. They are especially adapted to

HIGH SPEED ENGINES FOR ELECTRIC LIGHTING

Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

Liberal discount to the trade. Send for Circular and Price List.

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GEORGE P. BARTON,

Law Office

225 Dearborn St., CHICAGO.

Having removed my office to Rooms 68 and 69 Temple Court, 225 Dearborn Street, I shall continue the general practice of the Law, giving special attention, as heretofore, to litigation relating to Patents and Trade Marks

My experience in the Class of Electricity having been large during the last seven years, I offer my services as Solicitor of Patents, especially to those interested in electrical inventions.

June 1, 1887. **GEORGE P. BARTON.**

Our BELTING is tanned on the surfaces only; the **INTERIOR is RAW HIDE.**

Send for Our Valuable Book for Engineers and Belt Users. Free.
Agents in all Cities. Send for Trial Belt.

Our Belts are the strongest, most even and perfect Electric Belts made.

Holmes, Booth & Haydens,

25 PARK PLACE, NEW YORK.

MANUFACTURERS OF

Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

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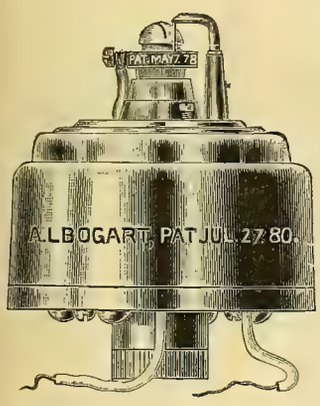
Western Agency, 185 & 187 Dearborn St., Chicago.

Headquarters for the West for all Kinds of Electrical Goods and Supplies.

WESTERN AGENTS FOR THE

A. L. Bogart's Electric Gas Lighting System.

SEND FOR PRICES.



WHOLESALE AND RETAIL DEALERS IN

Bells, Annunciators, Wire, Batteries, Etc.

ALOE'S

Improved Electric Watchman's Time Detectors,

The Best and Cheapest in the Market. TELEGRAPH and TELEPHONE SUPPLIES of every Description. ☞Send for Our Illustrated Catalogue No. 20 of Electric Goods.

ESTIMATES CHEERFULLY FURNISHED.

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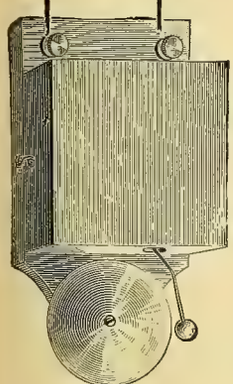
300 and 302 North Fourth Street, **ST. LOUIS, MO.**

HORACE VAN SANDS, ELECTRICAL SUPPLIES,

733 BROADWAY, NEW YORK.

Outfit, boxed for shipment, weighs 9½lbs.



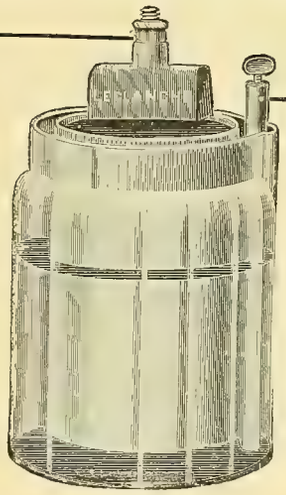
BELL.

$2.00

BELL OUTFIT.

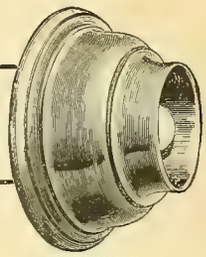
Bell	$1.00
Battery	.80
Push	.10
50 Feet of Wire	.15

BATTERY WILL LAST FOR THREE YEARS.



BATTERY.

OUTFIT DELIVERED TO ANY PART OF THE CITY FREE.



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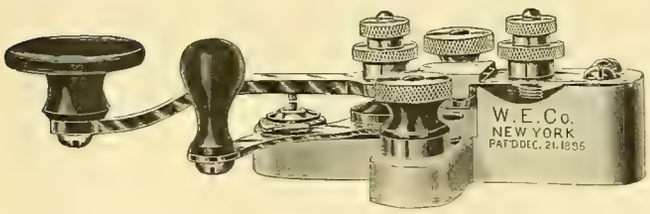
Paterson Cables for Telegraph, Telephone and Electric Light Uses, Overhead, Underground and Under Water.



The Steiner Key, with or without legs, is the best and cheapest in the market. We have abandoned the manufacture of all other patterns of Telegraph Keys.

Price, $2.00, subject to our usual discounts.

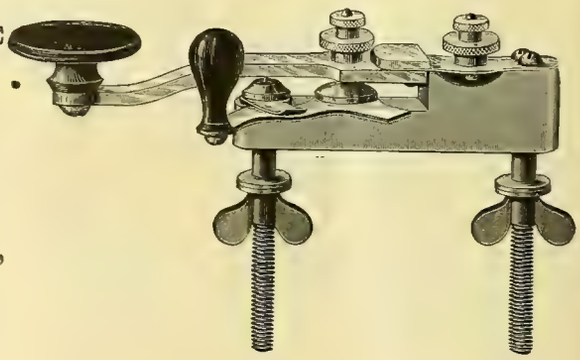
Apparatus for Electric Arc Lighting.

ELECTRIC BELLS,

Annunciators, Etc.,

FOR

Hotels and Residences.



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INSULATED WIRES, MAGNET WIRE, FLEXIBLE CORDAGE AND OFFICE CABLE.

TESTING APPARATUS.

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Miscellaneous Electrical Apparatus, including Edison's Electric Pen, Electro-Medical Apparatus, Batteries, Etc.

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Western Electrician.

EVERY SATURDAY.

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The Cleveland Motor.

We show on this and the subsequent page cuts illustrating the motor of the Cleveland Electric Motor Co., of Cleveland, O. Fig. 1 represents the seven horse power motor, and Fig. 2 the five horse power size. From the two cuts a very clear idea of the construction of the motor may be gained. It has a compact and substantial appearance, and at the same time is exceedingly neat and graceful in appearance.

To a certain extent the construction of the motor departs somewhat from the majority of motors in several essential points. The first noticeable feature is that the motor has but one spool, that being the bulky portion forming the lower part of the motor, while the armature is supported above, thus bringing it in the best possible position for attention.

As motor builders the company claim that they have the most compact, simple and durable mechanical combination for power purposes. To provide for the contingencies of use under varied circumstances by a great number of purchasers, many of whom are entirely ignorant of the fundamental laws of mechanics, the construction of the motor must be with an eye to simplicity and durability. The motor must be easy to watch, to get at, to clean, and to oil. These essentials are embodied in the motor shown.

The frame is made of a core of soft hammered charcoal iron. The two pole pieces are cast from the same pattern, and, as will be noted, the lower portions of the pole pieces are extended into feet upon which the motor stands. Mechanically, the motor is put together as perfectly as possible. Fitting surfaces are planed, turned or bored to exact measurements by jigs or templates, and it follows that parts of motors of the same size are perfectly interchangeable. There are but six cap screws in each motor, and in addition to them taper pins are so placed that the parts of the motor come together perfectly before the screws are entered.

The difficulty of arranging and harmonizing all the various mechanical sizes to the different electrical sizes has been conquered. For instance, the frame of a one horse power motor has five different spools and five different armatures adapted to different currents. Each of these spools or armatures exactly fits the frame, and it is possible to change the motor to run in any one of the five different circuits in ten or fifteen minutes. This feature the company prides itself on, and it will be recognized as being a very valuable one. As a rule, the armatures are of the plain Gramme type, but for some purposes they are made on the drum plan. Throughout all the changes specified, the electrical balance between the amount of iron and copper on armature and field has been so carefully computed that no undue heating or any sparking is entailed. As for regulation the constant potential machines being shunt wound are automatic and hence self-regulating. The method of winding and proportioning the fields is such that starting and stopping is easily accomplished. The first move of the switch converts the motor into an arc compound wound, and the final into a plain shunt wound machine. To stop, it is only necessary to turn the switch back into its original position. This simple and effective method does away with rheostats and other complications hung on the adjacent walls. The arc motors are in the main plain series, and are regulated by either a hand switch or by the governor, as suits the requirements. Their running and regulation is equal to that of the constant potential motors in every respect, but as important patents are pending a description is prohibited. Notwithstanding the versatility of the motors, their efficiency, irrespective of type or size, is very high, and this is an achievement of which the company may well be proud. The company has been called upon for estimates for equipping a number of electric tramways, and intends to push trade in that field, as well as in the field of stationary motors.

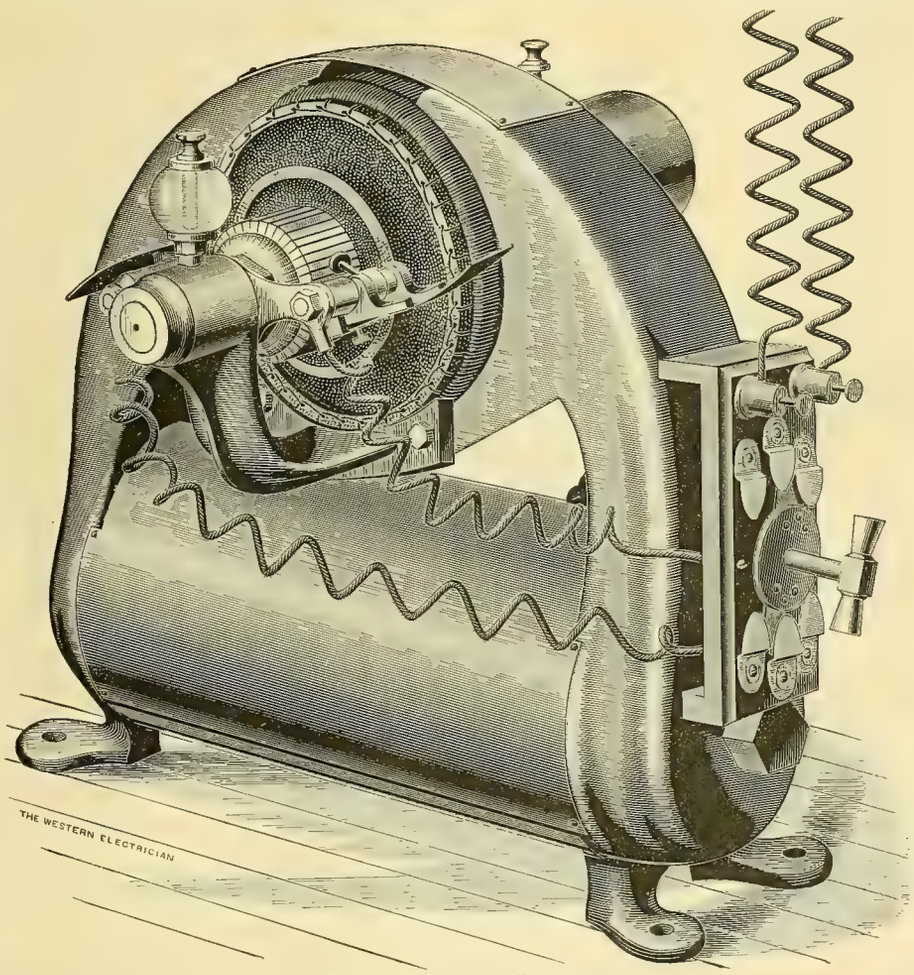


Fig. 1.—Cleveland Motor.

Electricity in the Mining Field.

Since the advent of the electric motor the mining fields of the far west have been closely considered by motor manufacturers as a market for their products. Many mines located at a distance from a suitable water power have been suffered to lie neglected for the reason that the cost of erecting and maintaining a steam plant has precluded working them at a profit. With the electric motor, however, generators can be stationed either at a water power or a central steam power, the current conducted to a mine at a distance and converted into power again, all at a reasonable cost, and a cost that encourages the development of the mine with the assurance of a return for the investment. Motor men are already at work in this field, and there is no question but that their efforts will be mutually beneficial to themselves and mining men.

The government of New Zealand has just issued a hand book on the mines of that country. For two years one of the Phœnix quartz mines, on Skipper's creek, Upper Shotora, Otago, has been run by electricity, and the handbook referred to has the following in regard to the plant:

"Messrs. Bullen, the enterprising proprietors of the Phœnix mine, have an example to the Australasian colonies which is sure to be followed; this is in the application of electricity, generated by water-power, to the purpose of driving the crushing machinery.

"The dynamos are fitted up in a spacious building, on a beautiful and most romantic site, on the right-hand branch of Skipper's creek, at a distance, following the surface up and down over the lofty spur that separates the branches, of two or three miles from the Phœnix battery. The dynamos are worked by two Pelton wheels, driven by a splendid fall of water directed through two strong iron pipes, with a pressure of about 120 feet. The dynamos are now working splendidly, and capable, in the opinion of Mr. Evans, of driving 25 or 30 head of stamps. The success of this system at the Phœnix mine opens up new possibilities in the way of driving crushing machinery in situations where steam can not be raised for want of fuel and where water-power is available. Here the water-power is two or three miles from the battery, and, it may be, at a lower level. The current is carried from the generating dynamos to the battery by a thin copper wire, supported like an ordinary telegraph-wire, on poles, and at the battery the electric current is reconverted into the moving power, which turns the wheel that drives the stamps."

Cost of Running an Electric Railway.

The Van Depoele Electric Manfg. Co. of Chicago have received from Montgomery, Ala., some interesting and gratifying figures on the cost of running their electric street railway system there. Charles J. Van Depoele, the electrician of the company, writes:

"The average coal consumption in Montgomery, Ala., when running 10 cars is 3,500 pounds in 18 hours. The cost of the coal per ton of 2,000 pounds is $2.00, or a total of $3.50, or 35 cents per car per day of 18 hours, for fuel. The cost of running 10 cars, each 10 H. P., for 18 hours figures as follows:

3,500 pounds of coal	$ 3.50
Wages of engineer	3.00
Wages of helper	1 50
Wages of fireman and helper	2 00
Oil and sundries	1.00
	$11.00

Or $1.10 for power per day per car.

"The above is the result of accurate data taken for a period of two months. The number of cars has been increased since the above data was taken. Four 15 H.P. motor cars have been added; each of these is capable of pulling two cars besides its own. In a few weeks we will be able to give the additional cost of the running the four 15 H.P. trains, besides the ten 10 H.P. cars. Let it be remembered here that on the five different lines in Montgomery, Ala., the grades vary from one to seven and eight per cent., there being not a single level line in the whole city, so that the expenses of running on a level road would be much less.

"From the above it will be seen that the larger the plant the cheaper will be the expense per car, since in the present case the largest amount is paid to engineer, etc., which would not be much increased in a plant four times as large, which goes to show the commercial success of our system."

New York's Electrical Board.

Last week the board of electrical control of New York held a racy session to the interest of which Mayor Hewitt added much.

Commissioner Hess read a report of Engineer Kearney, who submitted a plan of the work. He asked that the work be allowed to proceed as it now is going. He also submitted plans for putting a conduit down in Broad street.

The mayor asked if the distribution of the wires would not form a network of wires coming out of the conduit.

He was informed that a plan was in progress whereby the wires would be brought from a manhole of the conduit and carried into a building under the sidewalk, thereby avoiding the network.

The mayor didn't think it right to have the streets of the city torn up before a definite plan was settled upon to get the wires into a building, and said "as far as I am concerned, I shall not vote for the extension of a single foot of subway until some plan has been formed for the distribution of the wires. I do not propose to vote for any measure that will tear up the streets of this city and leave the city in a chaotic state while a scientific board is deciding how this distributing is to be done. It seems to me that the legislature has ordered this board to go on laying subways without any idea of how much work is to be done."

Engineer Kearney: "This building of subways, with the question of distribution unsolved, has been done at the express request of the Metropolitan Telephone company, and they would decide the question of distribution later."

The mayor: "Is this board to authorize the putting of wires under ground in its own way? or is the construction company to do it and the board of electrical control to sit by and see them? If that is the case, it would be better for the construction company to make all its plans and then this board could meet once a week, or as often as necessary, to obey orders."

Mr. Gibbens: "The distribution will be provided for, and I can say positively that there is no possible chance for the distribution by pole and overhead wires. I shall not stop in the work of putting wires under ground as long as I am in a position to press it; and I move that the construction company be instructed and directed to proceed with the extension of the route as laid down on Broadway."

Mr. Cohen of the construction company tried to explain the motive of his company in having the work done without the distribution being solved. Mr. Gibbens objected, but the mayor asked to have him given permission to speak in order that light on the subject might be given to the board. Mr. Cohen explained what was proposed to be done, but there was little in it to satisfy the mayor. He said that he would not by his vote allow the company to go on and build subways, without plans for connections which would do away with poles and overhead wires.

The mayor moved as an amendment that the permission be given to the construction company, provided that a plan for the distribution be laid before the board, before any work is done, which does away with overhead wires and poles.

The vote was put on the amendment and it was lost, the mayor voting in the affirmative. The vote was then asked for on the original resolution and the mayor moved it be laid on the table, which was lost. The resolution was put and carried, the mayor voting in the negative.

New Orleans' Tower System.

In New Orleans the tower system of the Star Iron Tower Co. of Fort Wayne, Ind., for carrying electric light, telegraph, telephone and other wires is to be used. From each corner will ascend an iron post 7½ inches in circumference. There will be no other obstruction up to a height of about 40 feet, from which point up guy rods will hold the posts in position. The whole

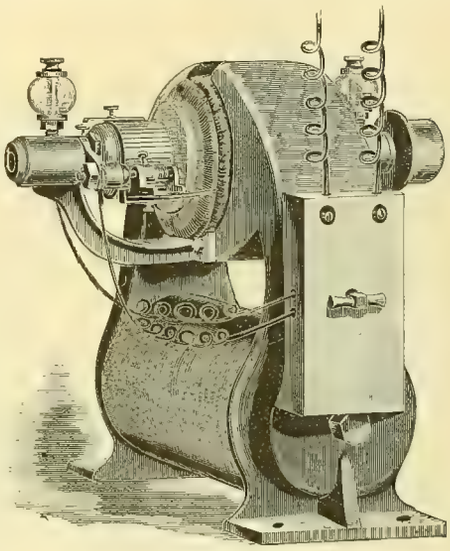


Fig. 2.—Cleveland Motor.

structure will be of malleable and wrought iron, each tower being about 150 feet high. At the top of the towers will be two steel cables, five-eighths of an inch thick. Some distance below will be two or three more cables on a line, these bottom cables being an inch in thickness. Between the two sets of cables will be suspended cross-sections sixty feet apart. These cross-sections will be of wood and iron and it is through them that the wires will pass. The construction will be exactly like that of a suspension bridge, except that the cross sections will be perpendicular instead of horizontal. Water pipes will also be attached to the towers to aid in extinguishing fires. The pipes will commence at a distance of about five feet from the ground and run to a height equal to that of the highest building, with openings at intervals. The pipes will be made so that a fire engine can force water through them, and hose will be attached to either of the openings and brought to bear upon the fire, in whatever story it may be.

A Sea Telephone.

A dispatch from Cincinnati, Ohio, says: At Fernbank, ten miles from this city, are the workshop and laboratory of Harvey B. Cox, a young electrician, who, though known to but few here, is attracting the attention of scientists and electricians in this country and Europe by his inventions, in which he is as prolific and ingenious as Edison. His latest device is a trumpet to be used for telephoning at sea, on which he has been working for some months. The invention is the outgrowth of his discovery of the great distance an echoed or reverberated sound will carry and the discovery that speaking-trumpets, if made to give the same fundamental note, would vibrate and produce the phenomenon known in acoustics as "sympathy." With this trumpet, conversation in an ordinary tone of voice was carried on between persons four and a quarter miles apart. People sitting at their windows or on their porches a mile away conversing in an ordinary tone could be distinctly heard, and in a couple of instances they were told the nature of their conversation and admitted that such had taken place. By listening to the whistle of a train and tracing it to and beyond Fernbank to Lawrenceburg, Ind., it was found that the instrument has a well-defined range of twenty-six miles; that is, a loud sound like a locomotive whistle or the rumbling of a train can be distinctly heard at a distance of thirteen miles in every direction. Conversation was readily carried on between two gentlemen on high hills on opposite sides of the Ohio river, about four and one-half miles apart. Tests made on the water showed that the trumpet was even more available than on land. The instrument will be patented as soon as perfected. A name has not yet been chosen for it. Mr. Cox has a great many other curious and valuable devices, both electrical and mechanical, but none as curious as his sea telephone.

The Detroit Electric Street Railway.

"Do you make any speed with the electric motor?" a reporter of the Detroit *Free Press* asked of Frank H. Fisher, inventor of the system in use on the Highland Park road.

"Come out and receive a practical demonstration," was the reply.

The invitation was accepted, and shortly afterward the young inventor and the reporter were at the power station. Here were found two dynamos, one for operating two cars and a larger one for handling six. These dynamos are driven by one engine, and it was impossible to tell that the machines were delivering the current to the track, there being no spark and very little noise. The current is taken to the car by means of a third rail, which, in the city limits is placed in a conduit entirely below the level of the street, but at the toll-gate it is raised somewhat and protected by wooden stringers on the remainder of the road. The equipment of the road has been largely increased, and cars now run every half hour. While inspecting the conduit the car Ampere came dashing down the track. It had hardly stopped when the crowd of waiting passengers began to scramble for seats. Mr. Fisher and the reporter took a position on the front platform. The conductor gave the customary yell of "all aboard," and then a signal to the motor man. The latter didn't yell "get up" and pound a tired horse with a whip. He simply moved a little switch and the car glided noiselessly and rapidly in the direction of Highland Park. The trip to the end of the road, which is three and one-half miles, was made in fifteen minutes. On reaching the switch, the car Volta passed without any perceptible difference of speed in either car. This explodes the erroneous idea that two cars going in opposite directions and propelled by electric currents can not pass each other. On the return trip, when the pretty stretch of road from the Post-office to Kaiser's was reached, Mr. Fisher gave a signal to the motorman, who moved another switch and "let her out." The car shot forward and rushed past Highland Park and Capt. Stevens' farm at a rate of twenty-five miles per hour. The speed was maintained until the switch was reached, when it slowed down to twelve miles an hour into the city.

The new cars, Franklin and Faraday, recently placed on the road, show marked improvement in mechanical construction. The motors are placed on the front platform, entirely out of the way of passengers, and there is an entire absence of wires and other paraphernalia. Each car is provided with an ammeter, which indicates the amount of current being used by the motor. The cars themselves, which were built by the Pullman company, of Detroit, are fine specimens of railway architecture.

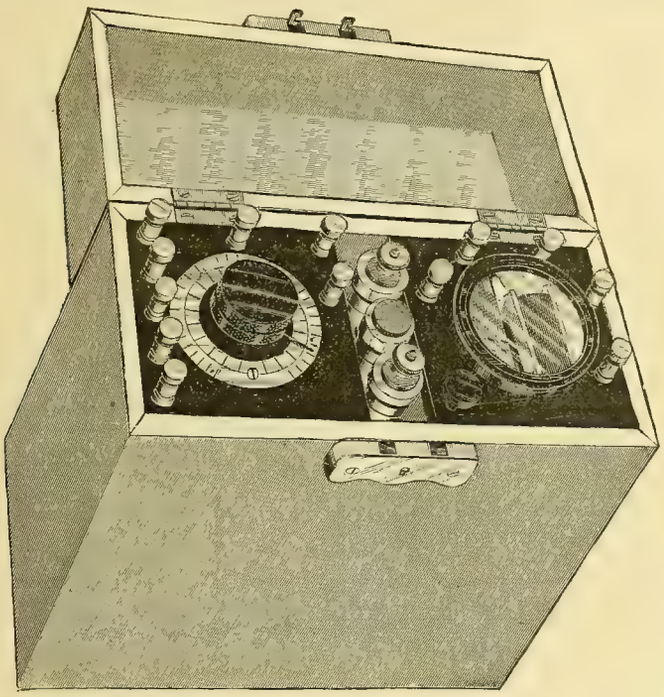
Improvements in Galvanic Batteries.

The invention just brought out by Sydney F. Walker, of Cardiff, Wales, is intended to supersede the Leclanchè and other batteries used for electric bells, telephones, and other light work. It exactly resembles the Leclanchè cell. It has an outer glass or earthenware jar containing a solution of sal ammoniac, a zinc rod or plate, and a negative element composed as follows: In a cell of porous earthenware is placed a carbon plate, with a lead cap or clamp attached, the space around being filled with a mixture of granulated carbon and sulphur, the top of the cell being pitched over as usual.

The working of the cell is as follows: When a current passes, zinc combines with chlorine in the sal ammonia, hydrogen gas and ammonia gas being set free at the carbon plate. The hydrogen combines with the sulphur at the carbon plate, forming hydrogen sulphide, which, however, immediately attacks the zinc chloride, forming zinc sulphide and hydrochloric acid. The latter combines with the ammonia to form sal ammoniac. The carbon and sulphur may also be formed into an agglomerate plate. It will be seen that the sulphur takes the place of the oxide of manganese hitherto used, and it is claimed that the cell has all the advantages of the Leclanchè, its simplicity, cleanliness, absence of local action, etc., combined with other advantages that the Leclanchè does not possess.

It will do the same work as the Leclanchè, but it is cheaper, it is said, and for the following reasons: It will be remembered that the office of the oxide of manganese in the Leclanchè is to provide oxygen to neutralize the hydrogen gas which is formed in the working of the battery; but, as is well known, a given bulk or a given weight of oxide of manganese can only give off a portion of itself in this process, so that there is a large amount of waste in any cell using oxide of manganese. On the other hand, with the sulphur cell, every particle of the sulphur can be used, and this results in an immediate saving, both in first cost and in maintenance. This saving is fully realized in practice. It is only necessary to use from one-half to two-thirds as much sulphur by bulk as manganese, the rest being filled with carbon. That is to say, where one uses half carbon, half manganese, by bulk, in the Leclanchè cell, one uses a third or a fourth sulphur to two-thirds or three-fourths carbon in the sulphur cell. This leads to two very important results—viz., the internal resistance of the sulphur cell is less than that of the Leclanchè, and the cost of materials is less. In addition to this, the cell should also use less sal ammoniac, as it will have been noticed that the reactions go to reform sal ammoniac. Further, the cell gives warning when it is being worked too hard. It is well known that one of the greatest drawbacks to the Leclanchè cell is that an accidental short circuit may occur, of which no warning is given, and then when it is required to use the battery it is worked down. In the sulphur sal ammoniac cell warning of this is given. Another feature is that it will stand short circuit better than a Leclanchè.

The cells are used in England for work which is considered the very hardest that a battery of that class can have to perform—viz., on the mine signals. In these there must be plenty of power, hard knocks, and insulation worthy of the name is a sheer impossibility. It is in this work that the warning properties of the battery are so useful. The signals, for the most part, consist of two naked wires connected to a bell or battery. The naked wires are on the engine plane road, and a signal is made by pressing the wires together. A simple switch is provided for disconnecting the battery when the signal is not in use. It sometimes happens, however, that the battery is not disconnected, and men going to repair the roads at night put the wires together. Next morning, with the Leclanchè, the battery would be burned and no one would have done it. Now, with the sulphur cell, the battery stands the strain, and reports the occurrence.—*American Inventor.*



The Wirt Voltmeter.

Where great accuracy in measuring electromotive force is desired the Wirt voltmeter will meet the requirements to an eminently satisfactory degree. The design is in accordance with the best principle of measuring E. M. F.; namely, the compensation principle or method. This is a zero method, so that no current is taken from the standard cell when a balance is effected. It is complete within itself and direct reading, no special skill being required for its use. Its accuracy is not affected by time, temperature, or proximity to dynamo or currents. Unsteady, undulatory, and intermittent currents can be measured with perfect accuracy. These conditions give rise to serious errors with ordinary voltmeters. The instruments carried in stock by the manufacturers have a range of from two to 150 volts but special instruments with any desired range can be furnished.

The coils and galvanometer have been so arranged that the instrument may be used for testing insulation, etc., and while not designed to take the place of special instruments for resistance testing, this feature will be found extremely useful.

The workmanship of the apparatus is excellent and no more convenient and portable device could be arranged.

The Electrical Supply Co., 171 Randolph St., Chicago, and 17 Dey street, New York, are the sole manufacturers.

A Supposed New Force.

At a recent meeting of the Royal society, Professor Crookes gave a description of the experiments of M. J. Thore which are attributed by him to a new force inherent in the human organism. The fundamental experiments are performed in a specially constructed apparatus, which consists of a glass box with movable windows, and containing suspended in it by means of a very fine cocoon silk fibre, a small cylinder of ivory, glass, or metal. By means of a ball and socket arrangement, a second cylinder, called the pillar, can be brought close to the first, and placed in different positions with regard to it. The cylinder is first brought to rest, and the observer sits down in front of the apparatus, with his face some 8 in. from the suspended cylinder. The pillar is then brought near to the suspended cylinder, when, on opening the glass window, it commences to rotate. This rotation is in the opposite direction to the hands of a clock when the pillar is to the right of the suspended cylinder.

It has also more recently been shown by M. Thore that the action is more marked when the observer's hand is touching the support of the pillar, and that if the right hand be used the movement is in the direction of the hands of a watch, but the opposite effect is noticed with the left hand. Professor Crookes is, however, of the opinion that the phenomena observed can be accounted for as the result of radiation, although he admits that at present this theory is not able to explain all the experiments which M. Thore has brought forward. That radiation can produce many such effects has been shown by the experiments devised by Professor Crookes when investigating these phenomena. A flask of boiling water, or a candle, or some other source of heat, causes the suspended cylinder to revolve in the same way as does the human face. And a bottle of hot water produces rotation when the observer is at a long distan e from the apparatus, when the movements can be examined by means of a telescope.

Radiation may give rise to the observed phenomena, either by producing a current of warm air, causing an indraught of cold air from all sides to strike against the suspended cylinder, and so determine its rotation, or an increase in the surface temperature of the two cylinders may produce a greater molecular pressure between them, and thus give rise to motion in the freely suspended one in a similar way to the movements produced in a radiometer. Professor Crookes suggests that experiments performed with the apparatus in tubes under diminished pressure might possibly decide which of these two hypotheses is the more probable.

Electricity Applied to Vehicles.

A company has been formed at Pittsburgh for propelling carriages by means of electricity taken from an overhead wire, as street cars are already driven in many cities. As soon as the system proves a success it is likely to be adopted in Buffalo, says the *Courier*, the asphalt pavements of which will offer great advantages. It takes from three to four times as much power to run a carriage on a stone block pavement as on rails. So fast has progress been made in experiments with electricity that careful tests show that 93 per cent. of the power put into a motor can be made available; a steam engine gives forth only 15 per cent of the value of the coal burned. When storage batteries have been made much lighter than they now are they can be used for driving carriages, instead of overhead wires, and they can be charged by means of wind mills and water power. Thus every farm house may come in time to be supplied by means of such devices not only with water but also with light and power for driving wagons and farm machinery. But long before that time the horse car will have given place in our cities to the electrically driven street car.

There are sixty electric bells on W. K. Vanderbilt's farm. With this chance for the appliance of annunciators, no hen can lay an egg without William knowing it.

Electric Road at the Newcastle Exhibition.

An electric tramway, which is, as might be expected, one of the most popular of the electrical exhibits, is shown by the same firm, says *Industries*, describing the exhibit of Woodhouse & Rawson at the Newcastle royal jubilee exhibition. The vehicle is not strictly speaking an electric tram car, but an ordinary car propelled by an electric locomotive. The motor is mounted on a bogie by itself, and has very conspicuous connecting rods and coupling bars. This system, which was adopted owing to the carriage being too light to carry the mechanism of the motor, has the further advantage that the motor and its surrounding magnetic field is sufficiently remote from the passengers not to affect their watches, a risk which might otherwise render electric cars unpopular. The car, which has been lent by the Nottingham Tramway company, is mounted on two four-wheeled bogies, and is capable of carrying forty-four passengers, making a total weight, including the locomotive, of about 12 tons. The empty car weighs 4 tons, and the locomotive 4½ tons. The motor consists of an Elwell–Parker vertical two-pole machine, with single horse shoe magnet. It is series wound, and runs at 800 revolutions with a current of 75 amperes and E. M.F. of 300 volts. There is a single pair of brushes specially designed to allow the motion to be easily reversed. They consist of two flat steel strips, each sliced for a considerable length into four tongues, and mounted by a detachable hinge on the two collector spindles, thus allowing of their easy removal. Each of the four tongues carries a small piece of gun metal, forming the surface of contact with the commutator. The free ends of the single strips are connected by india rubber bands with the spindle of the opposite strips, by which means is secured an elastic pressure between each contact piece and the surface of the commutator. On the armature spindle is mounted a 10-inch spur wheel of delta metal, gearing into a 3-ft. wheel of the same material, mounted on an axle passing across the bogie. This axle has cranks at each end, driving by connecting rods the wheels of the bogie, which are of the ordinary railway type, balanced and connected on each side by a coupling bar. Behind the motor is a wooden box containing iron wire resistances to the amount of 3½ ohms. The brake is of the ordinary type, fitted to the car alone and operated by hand. Current is supplied by an Elwell–Parker dynamo, which is situated in the extension of the electric light machinery shed, and is of the same size as the motor, but plain shunt wound, running at 1,000 revolutions. The line is about half a mile long, going round the north garden, and having some sharp curves. The maximum gradients occurring are one in fifty. The gauge is 4 feet 8½ inches, the metals being of the ordinary railway type, lent by the North-Eastern railway company. These rails, which are not insulated from earth, form one conductor for the current, zinc plates clamped between the fish plates and the rails being used to insure conductivity at the junctions. The other conductor is formed of a light flat bottomed rail placed between the other two rails and level with them. This rail is supported on asphalted wooden blocks 3 inches thick, into which it is keyed by a wooden wedge, at intervals of 6 feet, the rail being further insulated from the wood by sheet india rubber. The joints of the rail are connected electrically by the method already described. At each end of the bogie is an insulated arm, carrying on a short lever a small gun metal wheel pressed against the third rail by a spring. By these wheels the current is taken off the rail and transmitted by rubbing contacts on the wheels to a switch. The current starting from the central rail will thus flow first to the switch, then through the resistance—which may be cut out in successive portions—and from that through the field of the motor. At this point of the circuit is fixed a commutating switch, which allows the sending of the current in either direction through the armature, thus reversing the direction of motion. From the armature the current passes through the commutating switch to the metal work of the bogie, whence it finds its way back to the two outer rails. The car is started with all the resistance in circuit, but this is gradually cut out as the motor gathers speed. There are two sets of switches at the two ends of the car to allow the driver to stand at the front end of the car in whichever direction it is going. As the line is not closed upon itself the car must be pushed by the locomotive in one journey and drawn on the return journey. The trip occupies about one minute and forty seconds.

Magnetism in Watches.

At the last meeting of the New York Electric club, Lieut. F. W. Toppan read an interesting paper on magnetism in watches and chronometers. Prefacing his remarks by some historical points in the development of the finished watch and chronometer of to-day, and crediting John Harrison, a Yorkshire man, with the invention of the gridiron compensation early in the seventeenth century, the essayist said the defects still existing in fine time pieces of precision appertain mainly to the adjustment for temperature, and to such errors as are produced by the tendency of the metals used in construction of certain important parts to influences that can not be controlled, and one of the most prominent of these uncontrollable causes of disturbances, he said, was magnetism. The speaker referred to the grand strides the practical application of electricity has made, and stated that electricity applied mechanically meant magnetism in some form. "The appliances for generating electric light and motive power are pregnant with magnetism," said he, "contaminating the whole atmosphere surrounding dynamos, motors and wires. The chances of injury to chronometers and to watches especially, by magnetism, have been greatly multiplied by the development of the dynamo and its extensive application to electric lighting and other purposes; so it is very common to find magnetized watches in the hands of persons having no connection whatever with electrical appliances. A watch readily becomes sufficiently magnetized to derange its action and render it entirely unreliable. If the regulating part of a chronometer or watch—that is to say, a balance, together with the hair spring—should be badly affected by magnetism, which happens very often, it is clear that the time-piece will suffer more or less, according to the fineness of construction and delicacy of adjustment."

The speaker then spoke of the accomplishments of M. Paillard, the celebrated adjuster of Geneva, Switzerland, in having wrought a decided improvement in portable time-pieces. Various metals had been suggested to take the place of steel in balances, but it seems to have been left to M. Paillard, after fourteen years of experiment, to finally succeed in discovering and producing, in an alloy of palladium, a metal which is uninfluenced by magnetism or corrosion, and still retains those properties necessary to obtain the finest adjustments for changes of temperature.

"In producing his balance M. Paillard used two different alloys of palladium having a differential expansive ratio in similarity to that of steel. In so doing he, at the same time, gave us a superior balance, for the two metals composing the laminæ of his balance are congenial, both being made of a palladium alloy, and being fusible under different degrees of heat, having the necessary hardness and other qualifications. Numerous searching tests with balances in connection with the palladium alloy springs have given the most flattering results, and we have in chronometers and watches containing these balances and springs superior time-keepers uninfluenced by the hygrometric condition of the atmosphere or any spasmodical electrical condition of the same, and excelling all previous attainments with the steel and brass balance and steel balance spring.

"This question of magnetism and the necessity for protection of chronometers and watches against magnetic influences has called forth inventions of machines and devices for demagnetizing time-pieces that had become affected; also a sort of soft iron, shield or armor, for enveloping the watch movement, as a defense or preventive against magnetic influences. These are mostly cures after harm has been done. There would be no need of these devices if those parts of the chronometers and watches which control the time-keeping qualities were made of metals absolutely unaffected by magnetism, and yet possessing the other necessary qualifications.

"In the face of the certain fact, that electrical appliances shall become wider and wider in their range, and the aggressive tendency of electricity for lighting and as a motive power, both at sea and on shore, we must be prepared to meet its magnetic influence at every step in our industrial occupations. In the discovery of this alloy of palladium, a time-piece has been produced that is strictly non-magnetic and non-oxydable, and possessing those requisite and necessary qualities for fine and accurate adjustments to temperature and isochronism, and will take rank among inventions of the highest order in horological science."

It is understood that M. Paillard's valuable invention is not confined to Switzerland, but that it is utilized in America by the Geneva Non-Magnetic Watch company, of 177-179 Broadway, New York.

De Benardoz' Method of Electric Welding.

M. J. Sarcia in our French contemporary, *La Lumiere Electrique*, describes the method of M. de Benardoz of welding metals by electricity at La Chapelle: "The anvil is a cast iron plate mounted on an insulated table, and is permanently connected with the negative pole of the source of current, the E. M. E. of which must, of course, be greater than the counter E. M. F. developed in the arc employed. The pieces to be welded are placed upon the 'electric anvil,' as it is called, in the most convenient position for the work, and are thus put in contact with the negative pole automatically. The positive pole of the source of current is connected to an electric light carbon by means of a flexible conductor. The carbon is held in an insulated handle, which the workman holds in his right hand. In applying the carbon point to the part to be welded, the workman closes the electric circuit, and then, raising the carbon slightly, starts the voltaic arc which causes the fusion of the metals. He then carries the arc forward by hand, along the length of the junction of the two metals, and thus welds or solders them perfectly.

"The drawbacks and disadvantages connected with this process are such as might be expected to spring from the use of electricity in the manner indicated. It is apparent that the strength of the current must vary according to the nature of the work to be done. At La Chapelle the practice is to keep the dynamo working continuously charging a battery of accumulators, of which several batteries are at hand. By combining a suitable number of the latter, the requisite strength of current is obtained for the different purposes required. During working hours, it might be well to add, the employe protects his eyes from the glare of the arc by means of colored or smoked glasses mounted in a mask, or in a screen for holding in his left hand."

Edison and His Laboratory.

A smooth-faced, thick-set, youthful-looking man, attired in a gray suit and accompanied by two handsome young women, stepped briskly up to the desk of the Continental hotel office, says the Philadelphia *Times* of a recent date, and registered in a plain back-hand, "Thomas A. Edison, Orange, N. J." It was the wizard of electricity. The young women were his wife and sister-in-law. He appeared to be enjoying the best of health, and said the stories of his being at the point of death while in Florida were without foundation. He said he had come to Philadelphia to purchase electrical apparatus for his new laboratory at Llewellen, N. J. The laboratory, the erection of which he has just begun, will, when finished, be as large as the University of Pennsylvania buildings, and will be devoted entirely to experimenting. The machinery will be of the largest and most improved patterns, the machine shop alone being two hundred feet long. Mr. Edison, in speaking of the cost of experimenting, said that he had spent over $2,000,000 in experimenting, but as it was strictly in the line of his business, he had found it money well invested. In speaking of his Florida trip, he said he was so well pleased with the climate that he had erected a permanent laboratory on the banks of the Caloosahatchie river, where he will continue his experiments every winter.

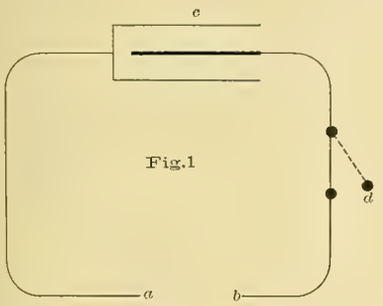
Theory of Telephone Cables.

By W. R. Patterson.

Part III.

The other factors which I believe are inherent in the use of cables are modified by the same elements as is capacity—distance between and shape of conductors. Therefore I maintain the most important specifications for cable work relate to the distance between the wires and the static capacity. Make the capacity low, and keep the conductors well apart; if possible, do it by using large cables; if not, do it by using small conductors. We shall not be very far from the truth if we say that for any or all circuits, a cable of .20 microfarad per mile is as good, if not better, than one of .30, without taking into account the resistance, say between 15 and 80 ohms per mile. Neither shall we be very far off if we say a long overhead line of copper with 20 ohms per mile is better than an iron or steel line with 30, without making guesses at the static capacity of either. If the combined circuit is short, the effects of retardation will not be felt; if it is long, it is the resistance of the line, and the capacity of the cable which are the large factors.

The theory that the working value of telephone circuits depends upon the factors, capacity and resistance alone would need for its demonstration and application accurate determinations of the capacity and resistance of such circuits. In general, the measurements of capacities and resistances are supposed to be simple processes, but to obtain accurately the aggregate capacity and resistance of a combined telephone circuit is a problem that requires the best of apparatus, the most favorable conditions of time and place, and the utmost skill and care on the part of the ob-



server. The disturbances from earth currents and induction are generally so serious upon long aerial lines that no accurate capacity tests can be made. We have to be satisfied with results obtained from calculation and the general assumption that the capacity of an aerial wire is about .015 microfarad per mile, and that it may be more or may be less, according to circumstances. With this factor necessarily to be given an assumed value, it is very easy to make the combination of factors, observed and assumed, agree with any preconceived idea.

In the case of long cables, capacity measurements, made by the usual method of comparison with a standard condenser, by observing the throw of the needle, are subject to possible errors which all tend to make the observed capacity lower than it actually is. The shunts which may be used, and which may be perfectly adjusted for continuous currents, may be seriously in error when used with discharge currents from a condenser or cable, and if correct for the condenser, may not be for the cable. The balistic galvanometer, which would give accurate readings, can very seldom be used in the places in which it is necessary to make the tests. The question of insulation also comes in. If it is perfect, one result is obtained; if, from a long reach of aerial cable in hot weather the insulation is low, part of the charge may leak out, and we get another result; if from dampness upon the terminals or lightning arresters, the insulation is low, there may be a counter E. M. F. established, which will cause us to get still another. Again, should all the other conductors in the cable be grounded "dead" at the cable ends or left in their normal condition as parts of working circuits, the latter is the condition of things which the circuit in question has to work against, but under such conditions it is very likely that no two consecutive measurements of capacity will agree.

The measurement of resistance is not attended by so many difficulties but the bridge and the telephone may tell opposite stories about the resistance of the circuit.

To illustrate, in Fig. 1 we have the wires *a b* with condenser *c* and switch *d* in circuit. Any ordinary test for resistance between the points *a* and *b* would show the circuit open whatever the position of the switch *d*. Telephone transmission however may be good between *a* and *b* if the switch is closed, and is not possible if it is open. We have a capacity of, say, .5 microfarad, multiplied by a practically infinite resistance and can talk well; by raising the temperature of the condenser we may reduce its insulation so that the resistance between *a* and *b* comes within the range of an ordinary bridge, giving an apparent product of 500,000 or so; still we can talk; we can short-circuit the condenser and talk; but in either case if the switch *d* is opened, our telephone circuit is opened, even if there is an escape through it much greater than through the insulation of the condenser. I do not mean to say that with a condenser in a telephone circuit we are actually talking through a resistance which is infinite to the telephonic current, or that resistance cuts no figure in telephonic transmission. We are, however, talking through something, which, as we ordinarily understand and measure resistance, is infinite.

This is one illustration of the fallacy of infering from the results obtained by observing one kind of current what another know will do under the same conditions. If we wish to know accurately what any current will do we must observe that current. The construction of a lightning arrester would never have been reasoned out by thought and investigation devoted to the laws of continuous and uniform voltaic currents, and I do not believe we are at liberty to infer from such laws the exact behavior of the telephonic current.

Without introducing some other factor or factors than capacity and resistance it is impossible to account for one phenomena which every one has observed who is familiar with the use of long circuits composed of cable at one end and overhead line at the other; that is, the fact that transmission is not equally good in both directions.

With the same product of resistance and capacity in each case, I believe telephonic transmission is affected by many details of construction and arrangements of circuits among which may be enumerated:

1. The shape of the conductor.
2. The material of the conductor.
3. The actual distance between the conductors in cables, independent of the specific inductive capacity of the insulating material.
4. The relative value of the factors of resistance and capacity which go to make up the product.
5. The position and relation of the conducting medium from which the conductor is insulated.
6. The relative position in the circuit of the portion of highest capacity.
7. The relative position in the circuit of any point of low insulation.
8. The relative position of a point of high resistance.

I think that practical experience will show that all of these conditions affect telephonic transmission even if they do not affect the aggregate resistance and capacity as measured from the same point in the circuit.

(*Concluded.*)

The Long Distance Telephone.

Long distance telephony has attracted the attention of electric inventors and the public generally ever since the invention of the telephone, and while much has been done toward its successful accomplishment much yet remains to be done. New interest has recently been awakened in the matter in the east, and the construction of lines on an improved system inaugurated. Copper wire of improved quality, substantial erection on posts of the best selected stock, and improved transmitters are among the latest indications of progress.

A practical, efficient telephone line involves far greater expense of construction and equipment than a telegraph line of equal length, while its capacity for transmission is far more limited. The duplex and quadruplex methods of transmission can be used with the telegraph, by which two or four messages can be sent simultaneously over a single wire, duplex transmission in the same direction or in opposite directions being practical and in common use; while the telephone is limited to a single message at a time in one direction only. Hence it is evident, that to obtain an equal percentage on the investment, the charge must be higher for telephonic than telegraphic transmission. But the advantages of the conversational method which the telephone affords makes its use very desirable, especially for business, while the expense in important transactions is often a comparatively insignificant item; hence there must always be a sufficient demand for long telephony to justify the expense.

The possibilities of the future in this respect are full of promise, and the realization of a more efficient system than has yet been developed must be near at hand. The substitution of copper for iron line-wire is an important step in this direction, and the substitution of cables for single wires is another step of equal importance. And if it is found practicable to put the cables for long lines as well as short ones in insulating conduits, safe from all interruption by wind, weather, accident and breakage, another important end will be secured. There still remains the necessity of further improvement in transmitters, and of some more effectual means of counteracting the effects of induction than has yet been discovered. But when we reflect that difficulties of far greater magnitude in electric transmission have already been met and overcome, there can be no doubt that electric invention will soon supply these requirements.

The expense of the cable and the underground conduit are of course great, but when compared with the permanent advantages secured, they are perhaps more economical than the air line and single wire. The cost of insulation, excavation, right of way, and similar items, when balanced against the advantages of a conduit containing seven cables of 150 wires each, 1,050 in all, is comparatively small; and when compared with the expense of railroad construction, involving grading, bridges, right of way on the surface, enormous equipment and running expenses, the cost of the telephone line sinks out of sight. On a financial basis alone the earnings of a long distance telephone line, constructed as above, when compared with those of a telegraph line must be, to some extent, a matter of experiment; and capitalists will be slow to invest till the certainty of a paying income is demonstrated: but the writer remembers when the comparative expense and advantages of the railroad and the turnpike were gravely discussed in the public prints, and the sage conclusion reached that the income of the railroad could never equal its running expenses; and hence that it never could compete with the turnpike.

Lines 100 to 175 miles long are now in successful operation in the United States, and by using large copper conductors direct transmission has been successfully accomplished on lines 1,000 miles in length. But, even if the message had to be repeated on long lines, very little delay or inconvenience would result; an expert at the repeating station, sitting at the transmitter with the receiving instrument to his ear, could forward the message word by word without a moment's delay, so that messages could in this way be sent from Chicago to New York, through three or four repeating stations, almost as rapidly as if sent direct; and the expert would acquire a quickness of ear and clearness of enunciation which would facilitate rather than retard the final delivery.

A section of the tramway system of Brussels is now again regularly worked by electricity. Each car for thirty passengers requires two sets of accumulators, each set weighing about 1,600 pounds. The daily distance run by each car is fifty-six miles, bringing up the weight of accumulators to 14 pounds per ton mile.

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QUARTERS have already been secured for WESTERN ELECTRICIAN representative at the Parker House, Boston, for the National Electric Light convention, which is to be held in that city August 9th, 10th and 11th. Members of the convention are cordially invited to call and avail themselves of the conveniences of the quarters.

A MECHANICAL contemporary suggests that it is time to hear from Mr. Keely again on his great "sympathetic etheric motor." The suggestion is in point, as some months have passed since he last bulletined success, as the customary preliminary to his usual draft on the pockets of confiding and undismayed shareholders. But by the time that wonderful motor is ready for practical use the electric motor will have left no field for it.

W. R. Patterson's articles on the "Theory of Telephones," we conclude in this issue of WESTERN ELECTRICIAN. His thorough knowledge of the subject of which he treats, combined with a clear, concise and vigorous use of language, have added a very important contribution to electrical literature. The value of the articles need not be dwelt upon; it is apparent to every reader and thinker on electrical subjects. We can only add that we hope to have more from Mr. Patterson's pen.

IT is a part of the duty of policemen connected with the patrol wagon service of Chicago to receive and profit by instruction on the subject of emergency duty. The chief surgeon of the department, Dr. Henrotin, recently delivered a lecture and gave instructions in regard to the handling of all manner of injuries, resuscitating the drowned and treating cases of sunstroke. Special stress was laid upon the necessity for discriminating between unconscious inebriation and apoplexy. A new ice cap to be used in cases of sunstroke will soon be added to the appurtenances of every patrol wagon.

IN this age of enlightenment, and to as well educated a class of men as the WESTERN ELECTRICIAN goes, it would seem entirely unnecessary to state that anonymous communications receive the same treatment in a newspaper office that they do in the household or counting-room, that is, speedy and sure interment in the depths of the waste paper basket. We can but rehearse trite words and say that we will not publish the writer's name as a signature to a communication, if it is not desired, but we must invariably have the name as a guarantee of good faith. Communications on matters of interest to those engaged in the electrical field are always cordially received, and will be given place, but we must know the source, and will be governed by the writer's wishes in regard to connecting his name with the communication. A letter in regard to the recent carbon combination has been pigeonholed pending notification of the authorship, which we believe will be forwarded after this frank statement of our position in regard to nameless communications.

IT is a noticeable fact that a very large percentage, if not all, of the recently incorporated street railway companies, in stating their proposed methods of propulsion in their applications for incorporation papers, always include electricity. The rapid advancement of the motor to the front rank in its applicability to such uses has commanded wide attention. Its universal adoption to the exclusion of other methods of motive power seems but a question of time, and meantime promoters of street railway enterprises are placing themselves in a position where they can adopt the electric motor when it appears advisable.

OUR Pacific slope correspondent this week describes a barrel of novel construction in which a sailor is to make a trip from Ocean Side to San Monica. It is about six feet long, and three feet diameter, with glass ends. The day of foolhardy attempts at navigation has not yet passed, it seems; but some interest is lent to this undertaking, inasmuch as the navigator proposes to hoist on his upper deck an incandescent lamp which will be furnished current by a storage battery, and which will serve as a warning light to vessels that might run him down at night. About the only comment that can be passed upon the undertaking is that if the sailor is bound to enter upon his perilous enterprise and fails, he has shown wisdom in his choice of the electric light as a means of illuminating his course over black and angry waters to death, and is to be praised for his experiments in the interests of electrical science with the storage battery under circumstances which may be styled somewhat singular.

SOME of our cotemporaries in directing attention to the frequency and apparent increase of damage by lightning, observed of late, and the resulting havoc among domestic animals, suggest the importance of inquiring whether wire fencing may not be responsible for the frequency and fatality of these phenomena

These fences are made of barbed wire from which millions of sharp iron points project into the air. Each of these points is a silent discharger of electricity, either conveying the atmospheric charge to the earth or the earth charge to the atmosphere, according as the atmosphere in the vicinity may be electrically positive or negative; and the millions of such points on a long line must greatly reduce the difference of electric potential between the earth and atmosphere in its vicinity, and thus afford protection to domestic animals instead of being a source of danger.

The only question would be in regard to the sufficiency of the earth connection. But the posts, though partial insulators, are so numerous as to afford, in all probability, sufficient connection with the earth, while the barbs collecting electricity at a part of the line under the influence of a high electric potential would discharge it at another part of lower potential, thus equalizing the potential and rendering any dangerous accumulation an impossibility.

Iron rods, connecting the wire with the earth at suitable intervals, would afford additional security, if such should be deemed necessary.

THE system devised by Professor J. P. Barrett, city electrician of Chicago, of connecting the bridges by telephone and moving vessels on the river by orders from a central dispatcher's office in the same way that railroad trains are moved on land has been in use since the 18th of July. The data for a comparison of the time the bridges are kept closed with the time they were kept closed under the old system are very meager, inasmuch as the records have not been made complete; but the record of the first few days' trial of the system, even under the disadvantages which attach to the inception of every new enterprise or system, show that the average time bridges have been kept closed exceeds the time they were kept closed under the old system, and hence a partial remedy for the bridge nuisance has been found. The data recorded show the number of vessels that pass a given bridge between the hours of 9 A. M. and 5 P. M., the number of times the bridge is opened, the number of hours the bridge is kept open, the average number of minutes it is open, and the average number of minutes it is kept closed. To those who have to cross the bridges the column showing the average number of minutes the bridge is kept closed is the one of most importance. In four days the longest average time the bridges were kept closed under the new system was 27⅜ minutes and the least was 15½ minutes, while in the whole of the preceding month, before the telephone system was introduced, the longest average time the bridges were kept closed was 20½ minutes and the shortest 12½ minutes, the condition as to number of vessels moving being substantially the same in both cases. The saving in time may look small and may not receive its just appreciation. In a former number of this journal it was shown that very nearly 64,000 persons crossed the most popular bridge in the course of twelve hours, or an average of over 5,000 per hour. With this fact for comparison the reader will appreciate the great value of even the few minutes that have been saved by introducing the telephone. At Chicago avenue, Kinzie street, Rush street, Clark street, Wells street, Lake street and Twelfth street bridges it has been found necessary to station operators. These are the more important bridges and it was deemed wise to place men with some knowledge of the telephone on them as the bridge tenders could not handle the telephone satisfactorily.

Under adverse circumstances the system has been tried and it has proved its value. When it has been thoroughly established it will unquestionably show much better results than have been reached, and that, too, at an inconsiderable expense.

Tamine's New Accumulator.

M. Tamine is at present engaged in experiments with a new accumulator having a slightly higher E. M. F. than the usual type, says the Brussels correspondent of *Industries*. Preliminary experiments have shown that the E. M. F. is 2.3 volts, and that it can be maintained during the discharge of two-thirds of the total capacity. The positive plate is of the Gadot type and the negative is of metallic lead, the solution containing the following: Saturated sulphate of zinc 1,000 parts, sulphuric acid 500 parts, sulphate of ammonia 50 parts, sulphate of mercury 50 parts.

More Queer Freaks of Lightning.

At Corning, Ia., it struck Frank Strait, and the points of the cultivator with which he was ploughing were melted and Strait was killed. The only mark on his body was a dark blue spot on the side of his neck. His shoes and stockings were torn to shreds. Lightning entered the residence of G. S. Meacham at Fruitland Park, Fla., and meandered around the premises until, meeting an umbrella leaning against the wall, it ripped out the ribs and made a bonfire of the cover. It then left by the door. In Richwoods, Ill., lightning peeled the bark from a tree, cutting it into six-inch pieces, and drove them into the weather boarding of a house several feet away, so that the whole front was decorated. Two persons at Marshfield, Wis. were struck, one of them upon the shoulder, the current passing down his leg and through the sole of his shoe, making a clean-cut round hole in the leather and entering the floor. The other was likewise struck on the shoulder, and the charge passed out through his slippers, making six clear-cut holes through the toe of each of them. Lightning made splinters of the foremast of the schooner Alfred H. Kemp of Albany, while the captain and crew stood upon her decks, yet not a man was injured.

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number V.

The Alternate Current Dynamo.—Dynamos are divided, according to the nature of the current generated, into two classes, the constant current and alternate current, according as the current flows constantly in one direction or alternately in opposite directions. For some purposes, especially that of electroplating, a constant current in one direction is an absolute necessity, as a reversed current would, in this case, remove the metal deposited by the direct current; but in electric lighting it is a matter of less consequence, continuity and steadiness being of far greater importance than direction of current.

It has already been shown that the continuous current is made up of a succession of transient, momentary currents collected into one; and that by means of the commutator these are all made to flow in the same direction. But for the purpose of continuity, it is immaterial whether these momentary currents are in the same direction or in opposite directions, provided there is no perceptible break between them. The case is analogous to that of a circular movement as compared with an oscillating movement in mechanics; the rapidity of movement in each case may be such that the eye cannot distinguish between the separate impulses, so that the oscillating may appear as continuous as the circular.

Thus far we have confined our attention to the constant current dynamo, but in certain departments of electric lighting the alternate current dynamo is preferred, hence its description here is of importance. Fig. 11 is a fair illustration of the style of construction as found in several machines of this class, and shows the typical points of difference between these dynamos and those we have been considering. Here it will be seen that both the armature and the field magnets are composed of a number of coils, wound on bobbins, and attached to the circumference of circular supports. In the cut the supporting ring and also the bobbins are omitted from the armature, the coils alone being shown, so as to give a better illustration of the movement of the currents. The planes of the armature coils are parallel with those of the field magnets, and the direction of rotation parallel to the planes of the coils, the axes of the coils being parallel to the axis of rotation. In some of these machines the armature coils have iron cores,

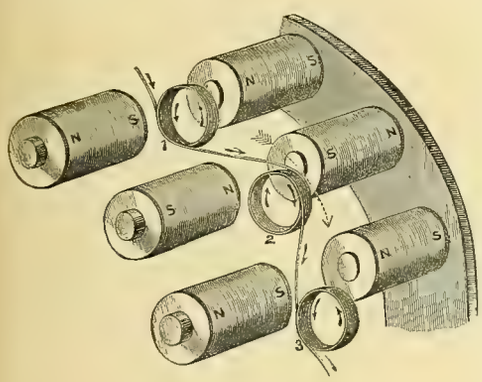

Fig. 11.

while in others the cores are of wood. The Siemens-Halske alternate current dynamo is constructed in this way; copper ribbon insulated by vulcanized fibre being used for the coils instead of wire.

By reference to Fig. 11 it will be seen that the north and south poles of the field magnets alternate in position, opposite poles facing each other in the usual manner. As this causes a reversal of direction in the lines of magnetic force between each alternate pair of magnets, a corresponding reversal of current is produced in each alternate coil, as shown by the position of the arrows; and as these opposite currents would neutralize each other, this again is compensated by a reversal in the winding, the wire as it leaves the bottom and front face of one coil, being led over to the top and rear face of the next coil, so that the momentary armature currents, generated as the coils simultaneously pass the field magnets, all flow in the same direction, as shown by the arrows between the coils, while at the next instant this current is reversed, as the rotation changes the position of the armature coils. So that, following any one coil as it rotates, there occur as many reversals as there are pairs of field magnets.

Instead of the commutator these machines have a collector similarly placed, as shown in Fig. 12, consisting of two flat metal rings, mounted on the shaft, and insulated from each other. To these are attached the two terminals of the wire composing the coils, as shown, and each transient current generated passes into the outer circuit through the brush which presses on one

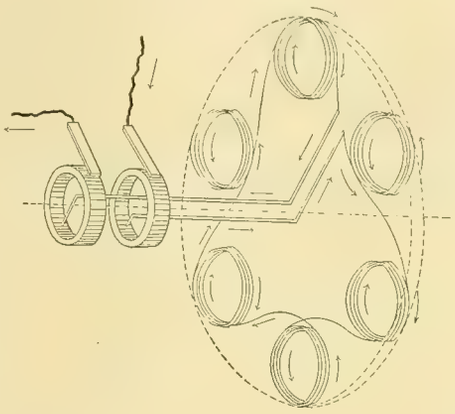

Fig. 12.

ring, and is returned through the brush which presses on the other ring, traversing the outer circuit and armature coils in the direction indicated by the arrows at one instant, while at the next this direction is reversed, as already explained.

Wooden cores are preferred to iron for the armature in the type of alternate current dynamos which we have been considering, the great intensity of the magnetic field, and the incessant reversal of polarity in iron cores with each reversal of current in such machines, generating the Foucault or eddy currents in the cores, and thus reducing the energy by heating. As the object of the iron core is to increase the magnetic intensity, and to prevent its loss by leading the lines of force through the coils, it is evident that it can easily be dispensed with in a field already sufficiently intense, and between poles separated only by the thickness of the armature instead of its diameter.

There are two methods of connecting the armature coils in alternate current dynamos, known respectively as the series and the parallel. These are illustrated in Fig. 13, the series method at A, and the parallel at B. In the series method it will be seen that the current flows from coil to coil by a single wire, while in the parallel method the ends of each coil are joined to two separate wires, and the current divided between them. The series method gives the greatest E. M. F., or electric pressure, and also the greatest internal resistance, while in the parallel method the internal resistance is reduced, and also the E. M. F., or pressure, and the volume of current increased in the same ratio. This becomes apparent when we consider that since resistance in a conductor is inversely as the area of its cross-section, doubling the number of wires, if of the same size, doubles this area, halves the resistance, and doubles the volume of current. But since electric current and electric pressure are mutually dependent, increase in volume of current reduces pressure. Hence if, in electric lighting, large current and small pressure are required, the parallel method is preferred, while if high pressure and small current are required, the series method has the preference. In both methods the alternate coils are wound in opposite directions for the reason already given, as shown in Fig. 13.

Experiments made in France in deep sea photography have been successful. With a camera and the electric incandescent light, it is said to be possible to photograph sunken ships, and make simpler the diver's perilous work.

The Graphophone.

Two week ago at Milwaukee, before the Business Educators association, a public exhibition of the graphophone was given. The graphophone is in principle very much like the phonograph, but in place of the bar containing the arm for the needle is a brass cylinder about nine inches in length by an inch and a quarter in diameter, covered by a tube an eighth of an inch thick, that makes the whole look like a very dimunitive press roller or a short section of wax candle. This cylinder is geared at one end, the other fitting in a socket about three inches in height. Unlike the phonograph, the graphophone does not gather up conversation from a distance, but prefers to have it whispered in its ear. For this purpose is provided a flexible rubber tube similar to those in use by deaf persons. Putting this to his mouth, the operator begins pumping the treadle, and when well under way presses a spring, throws the machine in gear, and then begins talking down the tube in such tone of voice and at such a rate as he sees fit. In the meantime a little needle pointed finger is sensitively reflecting the vibrations of the diaphram and industriously digging away into the waxy-looking substance on the cylinder, tossing up a thin, fleecy skein of the material that has to be removed by a brush when the cylinder is full.

The operation of writing on the graphophone is a similar process to that of turning a thread on a screw, only when completed an inch contains from 140 to 156 of these threads. To reproduce the words spoken the needle-tipped arm is removed and another with not so sharp a point is put in its place. This is clamped loosely on a lower bar with cut threads, and runs along the threads of the waxen tubes, following closely each undulation. The receiver puts on a pair of ear-caps, which run under the chin into a small rubber tube that connects with the finger of the instrument. Then the treadle is started, a spring pushed, and a voice from nowhere comes pouring into the receiver's ears with a distinctness that is rather likely to startle a novice. Round and round, up and down, the little pointer goes, being hung by a taut silk thread and reflecting back by this means the vibrations which produced the words on a smaller diaphragm, and thus to the ears. There is no means of regulating the machine so as to obtain a slow and uniform speed in reproducing. The words come out with the same rapidity as they are spoken. An amanuensis writing from the machine can, however, secure any desired degree of slowness by alternately slowing and starting the cylinder.

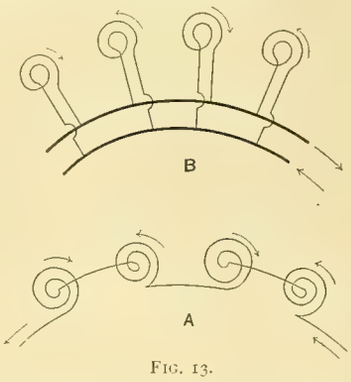

Fig. 13.

Geibel's Dynamo Regulator.

W. Geibel, of Edinburgh, has invented a device for regulating the current of a dynamo by means of a regulator, consisting of an adjustable resistance controlled automatically by a magnet or solenoid and a sensitive relay, the relay being arranged to throw the regulator magnet or solenoid into circuit or a shunt as may be desired. The adjustable resistance may consist of a number of carbon plates or disks of any desired thickness resting on one another in a column whose resistance is varied by the pressure due to the attraction of the solenoid, and which is brought to bear on the column either directly or through a system of levers; or it may consist of a number of resistance coils whose aggregate resistance would be varied by a sliding contact operated by the magnet. The relay consists of a magnet arranged to make or break contact with a given strength of current and an adjustable spring or weight.

Spagnoletti's Locking Apparatus.

C. E. Spagnoletti, of London, has recently taken out British letters patent on improvements in electrical locking apparatus for working railway trains. The object of this invention is to render it impossible for a signalman to work a signal at stations, junctions, or crossings without the coöperation of the signalman at the block station in advance, who is controlled by the arrival at or the departure of the train from a given point. This is effected by a treadle electrical contact disconnector, which breaks a circuit when a train or engine passes over the rail under which the treadle is fixed, and takes the lock off the signal lever in the rear for a following train. A series of flags or disks are also used, one fixed and two movable. The front movable disk shows "lock off." On the signal "train on line" being sent from the station in the rear, the front disk drops through the aid of an electro-magnet, and exposes the second movable disk labelled "train on line," and on the arrival of the train the second disk is moved by the action of a magnet in the treadle circuit, and the fixed disk showing "line clear" then becomes visible. The inventor makes twelve claims for the improvements described.

A Portable Telephone.

A cablegram from Brussels dated the 24th inst. reads: Two Belgians, Colonel Renard and Mr. Nothomb, the latter a professor of technical telegraphy, have just made known here a wonderful discovery, namely a portable telephone wherewith telephoning is easy on open ground from anywhere to anywhere by means of a copper wire worked by a small but astonishingly powerful electric generator. Regiments in warfare could carry wire and be able to communicate with others by simply throwing the wire on the soil and rolling it round a sword fixed in the ground to form a circuit, and then talking through a small box. Said telephone also acts as a telegraph, and can be used as a substitute wherever telegraph wires are cut. Experiments made between Brussels and Antwerp show transmission so perfect that the sound is heard even at several yards from the receiver. A portable telephone already exists in Germany, but the cost is so dear and it so constantly gets out of order as to be impracticable.

Western Electric Co.'s Addition.

The new addition to the factory of the Western Electric Co., at the corner of Clinton and Congress sts., Chicago, will have a frontage on Clinton street of 56 feet, running back on Congress street 150 feet. The Clinton street front will be of pressed brick, with stone and terra cotta trimmings, uniform in style with the present building. The Congress street side and the rear end, up to the level of the main floor, will be of iron and glass, so as to allow all the light and ventilation possible in the basement, which will contain the japanning room, brass and zinc foundry and nickel plating room. The construction of the walls above will be the same as the present building. The first floor above the basement will contain the heavy machinery for the manufacture of dynamos, the testing room and electric light plant for lighting the building. The two floors above will be used as part of the general instrument department, and the fourth floor for the assembling room. The construction throughout will be as near fire-proof as is practicable in a building for manufacturing purposes. All the interior supports will be iron columns carrying the main girders of steel. To these will be riveted smaller beams, each built up of two channel irons, bolted together back to back, separated by two inches of hard wood. This wood will allow of the attachment of the hangers for shafting on the under side, and for the fastening of the floor above. The floors will be double—three inches of tongued and grooved plank, with an inch of hard maple laid diagonally for the top surface. The basement floor will be of cement and iron, and the roof of iron beams and hollow tile. The iron stairways and the closets will be inclosed in brick walls exterior to the building. All the partitions will be of brick or corrugated iron. The completion of this building will increase the present floor space over fifty per cent.

Besides this addition, work is in progress on a two-story blacksmith shop 30 ft.x30 ft., and a lumber drier 20 ft.x68 ft., also of two stories. Contracts for the construction of the wing were let August 1st, and the work will be pushed vigorously. The entire cost of the building and improvements will be about $65,000.

Death of Thomas Pryor.

Henry H. Pryor, president of the Woodbury Engine company, Rochester, N. Y., recently lost his father, Thomas Pryor, by a shocking accident. Thomas Pryor had been connected with the company and its predecessors as superintendent of pattern making for thirty years. At the time of the accident he was high up on a ladder looking for patterns; he slipped from the ladder and in falling struck his head on an iron planer which cut a terrible gash and produced concussion of the brain. He lived but a few hours and did not regain consciousness. Thomas Pryor was a man of sterling integrity and was held in high esteem by his townsmen. His ability and skill in his department were unquestioned. His loss will be keenly felt by both his fellow-citizens and those withwhom he was intimately associated for so many years.

CORRESPONDENCE.

News From New York.

New York, July 30.—Arrangements are nearly completed for the electrical exhibition to be given this fall at the American Institute by the New York Electrical society, and judging from the number of applications for space already received the exhibition is an assured success. The display will be particularly large of motors, storage batteries, electric railways and arc and incandescent lamps.

The workmen are putting the finishing touches to the Metropolitan company's building on Cortlandt street. It is an eight-story building, built of pressed brick, trimmed with cut stone, and presents a very handsome front. The three upper stories are reserved by the Metropolitan company, excepting half of the seventh floor, which is occupied by the offices and operating room of the American Telephone & Telegraph company. Among the tenants who have taken offices in the building are the following: Hudson River Telephone company, New York & Pennsylvania Telephone company, Staten Island Telephone company, New York & New Jersey Telephone company, Standard Underground Cable company, American Electrical Works, New York Isolated Accumulator company, Telemeter company, Westchester Telephone company, and the American Electric Manufacturing company. It looks as though this building was destined to be the headquarters for the electrical interests of this city. The entire top floor will be used as an operating room, and when the new multiple switchboard is put in operation it will be the largest and one of the best equipped exchanges in the world. The board occupies three sides of a quadrilateral, being built around three sides of a court. By this arrangement perfect light is obtained for all parts of the board. The cables are brought into the operating room through goose necks placed in the roof and run to one side of the lightning arrester on the distributing boards. From the other side of the lightning arrester the lines are carried through the distributing board to the drops. This distributing board is placed against the wall in the rear of the switchboard and is a very ingenious arrangement for making the transfer from the cable through the arresters and by a transfer wire to the subscribers drop. One of the novelties of the keyboard of this switch is the color of the cords. They are arranged in groups of three, one red cord, one white and one blue. The shutters of the clearing out drops are painted to match, and as the operator can thus catch the colors, greater speed can be attained. It is expected that the Western Electric company will finish its work on the board by the first of August, when the Metropolitan company will take possession. They are now running their cables into the building, and hope to have a portion of the board in operation by the first of September.

Another opposition telephone company is proposing to lock horns with the Bell company. It is the American National Telephone company, operating under the Banta patents. Rumor says that the Standard Oil people are interested in it, and propose to begin business at once.

This has been a week to try lightning arresters for the air has been full of electricity and thunder storms have been frequent and severe. On Tuesday night the lightning performed some queer freaks in addition to its usual occupation of burning out instruments and raising a commotion in the Western Union operating room. The electric light wires on lower Broadway were burned through and all the lamps extinguished, and at Hudnut's pharmacy a ball of fire was seen to run down the iron column supporting the ceiling in the center of the store and explode upon the floor. The signal service officer at the top of the Equitable building was thrown off his feet and completely stunned, though not otherwise injured. A number of others experienced the same treatment, and two cases were reported where the injuries were fatal.

Charles T. Brady, who superintended the wiring of the Cortlandt street multiple board, was recently presented a handsome gold watch by the employes of the Western Electric company who assisted him in that work. Mr. Brady's western friends will be pleased to hear of the esteem in which he is held by his assistants. S.

From the Pacific Slope.

San Francisco, July 22.—The engines for the Hotel del Coronado, at Coronado Beach, San Diego, Cal., electric light works arrived a few days ago from the east. They are of 100 and 150 horse power and of the most approved Corliss patent.

A proposition to light Telegraph avenue, at Oakland, with electricity for its entire length is being considered by the property owners on the avenue.

The Amador *Ledger* says: "We understand that the owners of the Kennedy mine, near this place, are talking of lighting up their mill and mine with electric light in the near future. The South Spring Hill mine, at Amador City, Cal., has been using the electric light for some time, and we understand the result has been very satisfactory to the owners." This plant is run by water power.

An electric light plant is being put up at the Arroyo Seco gravel mine, Amador county, to better enable work to be carried on at night. The mine has been run day and night, coal oil lights being used.

A telephone line is to be built at once between Seattle and Tacoma, W. T.

Articles of incorporation were filed in the clerk's office at San Diego, July 20th, of the Elsinore Electric railroad company. The road to be built will be about thirty miles in length and will make the circuit of Lake Elsinore in the northern part of this county. Rails have been ordered and work will commence immediately on the extension of the motor railroad from the Sweet Water valley, its present terminus, to the Otay valley, which is several miles nearer the Mexican line. Grading is nearly completed and ties are on the ground for several blocks of the electric railway on North street, this city, and the rails are laid on the plaza in old San Diego on the San Diego and Old Town electric road. A company has also been organized at San Diego to build a motor line from the upper end of Fifth street, San Diego, over the mesa to Eel Canyon, fifteen miles. The route is being surveyed. The motive power is to be electricity. This makes the fourth electric road in the city of San Diego, Cal.

At Los Angeles, July 17th, with three passenger cars the electric railway carried 2,200 passengers an average distance of four and a half miles. Had sufficient cars been there at least 5,000 persons could have been carried. Additional cars have been purchased, but have not yet arrived.

James Nicholson, a sailor, has arranged a barrel about six feet long and three feet diameter, with glass ends, in which he intends to sail from Ocean side to San Monica. He has an incandescent light on top, run by a storage battery,

his purpose. He will start on the 25th inst.

costs, was granted on the 22d by Judge Reardon in the case of the Western Union Telegraph Co. against the Pacific Coast Electrical Construction Co., submitted on the same testimony as was adduced on the motion for a temporary injunction. The action was to enjoin the defendant from erecting electric light poles and lines in Oakland on Broadway, on the same side of the street where the plaintiff had erected its poles and lines, and in such proximity as to seriously interfere with the telegraph company's wires in the transmission of messages.

The building of the new Hotel Rubidoux at Riverside, Cal., was begun July 25th. This will be the largest hotel in Southern California, excepting the Coronado. It will have all the latest electric improvements, such as annunciators, thermostat fire alarms and return calls; also [illegible] lights, which will be run by water power. It is expected that the house will be open to the public January 1st, 1888.

Virginia City, Nev., with a population of 12,000, wants electric lights.

The citizens of San Diego, Cal., say they must have a fire alarm system before the year is up.

Hecht Bros., the wholesale boot and shoe merchants of San Francisco, are going to build a most thoroughly equipped and expensive manufacturing building on Valencia street near the terminus. It is to be lighted by glow lamps. All the small machines are to be run by an electric motor. When complete the building will cost not less than $100,000.

The California Electric Light Co. have consolidated with the California Telephone Co., and put in a new set of poles the full length of Market street and other places throughout the city. This looks bad for underground systems as each of these companies has a franchise for underground conduits in San Francisco.

There is trouble brewing in the San Francisco fire alarm and police telegraph system. Alfred Clark, jr., an operator in the fire alarm and police telegraph office, it is said, has been allowed to make the proper work of that office secondary to his own interests. He has four hundred or more gongs, so it is alleged, rented to fireman and others, which bring him in a revenue of about $1,000 a month. He has not gained the consent of the supervisors to use the city's wire, poles and batteries. S.

Detroit's Budget.

DETROIT, Mich., July 30.—The underground question has again come to the front. The city authorities having determined to enforce the underground ordinance, took the initiative step July 27th, compelling the Brush Electric Light Co., under penalty, to stop further construction. The company complied, but next day appeared in court and asked that a day be fixed to hear a motion for an injunction restraining the city and board of public works from interfering with the work of erecting poles and wires within a radius of one mile from the city hall, and from attempting to take down any poles erected, or to be erected, within the radius mentioned.

July 25th, the board of public works resolved that all telephone, telegraph and electric light wires in process of construction or extension, be taken down and removed, and under penalty forbidding the Brush company from connecting its wires with its new works—two miles from the city hall—with the system of wires and poles in the city. The board of public works claims to act under a resolution of the board of aldermen, adopted November 24th, 1885, and by the same resolution concurred in by the council on November 27th, 1885, requiring the Brush company to be notified and directed to remove and permanently place underground after January 1st, 1886, all wires within a radius of one-half-mile from the city hall, and all wires beyond the half-mile radius within one year from January 1st, 1886. This resolution purports to have been adopted in accordance with an ordinance relative to the removal of telegraph wires approved January 10th, 1882. The Brush company allege that the last ordinance which has been adopted under a resolution of the council is applicable only to telegraph companies wires, and the resolution last adopted is unauthorized and void so far as it attempts to apply to the Brush company; that the ordinance grants the right to the Brush company to erect poles, etc., in the streets; that the company is required to remove its poles and place its wires underground whenever the training of wires underground is deemed by the council to be practicable and as yet the common council has passed no such resolution. The company also sets forth that within a one mile radius of the city hall its conducting wires aggregated 200 miles in length and have cost the company $40,000; that the poles sustaining the wires have cost $10,500 and that the conducting wires can under no circumstances be used under ground, and the disuse of these would result in a loss of material alone to the company of over $50,000; that so far no successful system has been devised by which the arc current can be carried under ground; that to put the wires within a radius of one mile from the city hall under ground would cost $500,000, which expense it is unwilling to incur for an experiment, unless obliged to do so. Thursday next has been fixed for hearing the motion. Both the Brush company and the city authorities are anxious to bring the matter to a final conclusion.

The board of aldermen has concurred in the resolution of the lower house, awarding the public lighting contract to the Brush company. The contract runs for three years. C.

Indianapolis Items.

INDIANAPOLIS, July 31.—By the bursting of a flue in the boiler at the Brush electric lighting station here Friday evening last they were compelled to shut down, leaving those who depended on them for light in the dark. Repairs were immediately begun and the works were in running order again last night.

Charles Reitz, manufacturing electrician, reports business very good. He is now making a specialty of medical cabinets and is turning out some fine work. While your correspondent was at his place he was shown a cabinet made by him for a Philadelphia medical college in 1876, and which was exhibited at the Centennial exposition. The machine has been purchased by the surgical institute here and turned over to Mr. Reitz to overhaul and put in working order. Charles Reitz, jr., has left his father's establishment and branched out for himself in the electroplating business. He has all the work he can do.

Among the new enterprises under way here is the new Union railway passenger station, the main building of which is 150 feet square, three stories high, the passenger sheds to be two squares long. The whole is to be lighted by electricity.

From present indications it is more than likely that the new street railway line to be constructed from Haughville to Woodruff place will use horses instead of electricity as was first intended. The promoters claim the line will be built in such manner that a change to electric motors can be made at a small cost.

The police commissioners of this city have for some time past had in view a plan for a telephone system. The idea is to divide the city into three districts, each to be in charge of a sergeant with a telephone station in direct communication with the station house. In addition to this there will be put up as soon as arrangements can be made, about a dozen other telephones in different parts of the city to be connected with station house where an exchange will be established. Under the present arrangement the police have to depend on telephones at the fire engine houses and valuable time is lost in many cases where a patrol wagon or more help is necessary on short notice. M.

Cincinnati Chat.

CINCINNATI, July 31.—While all our neighboring cities and towns have been alive electrically, Cincinnati has by no means been sleeping, as everything indicates. We are soon to have in operation an electric railway running to one of the beautiful suburbs for which this city is noted. The cable road has the lead among the suburban roads at present, but some of the more wide awake and enterprising capitalists could not rest until they had the latest, hence a company was formed, calling themselves The Cincinnati Electric Railway Co., and work will be commenced at once. Your correspondent was not informed what system will be used, but a committee will be appointed to investigate the different systems now in use, and, as is customary with the Cincinnatians, nothing but the best will do.

A call at the Brush Electric Light Co. found them hard at work fitting up and trying to get things in shape after the recent fire. L. H. Weisledder, as superintendent, has proved to be the right man in the right place, as was shown by the short space of time in which he got things in working order. While they are cramped for room in their present office, they expect to have everything complete in a short time.

The Standard Electrical Co., pioneers in their line here, report trade better than for some time past, and the same good news comes from other firms in the same branch of industry. The trade in electrical supplies is as yet in its infancy in this city, but it promises to be in that, as every thing else, among the first.

At the representation of "Rome under Nero," which will take place in this city, commencing August 1st, no pains have been spared to make it more successful than any previous effort of the order. The campus has been greatly improved since last year, and seats for 12,000 people have been provided. A special plant has been erected, and the stage hall and all will be lighted by electric light, using in all about 200 sixteen candle power lamps. M.

Pittsburgh Notes.

PITTSBURGH, July 27.—One of the late interesting features in electric lighting is the progress made by the Allegheny County Light company in putting down their underground system. They are now at work and are pushing it as rapidly as possible. This company is also doing a large motor business, having some forty motors of various sizes, from an eighth up to a fifteen horse power in service.

A visit to the Westinghouse Electric Co. disclosed the fact that they are crowded with work and running overtime.

The Daft Electric railway on the south side, Pittsburgh, is progressing very slowly and it will be some weeks before the road will be ready to be operated. G.

Telephone Stock Quotations

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	395	400
Central Union	45	46
Michigan	76	77
Great Southern	30	33
Colorado	20	22
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27

Personal Paragraphs.

Dr. O. B. Bird, of Los Angeles, Cal., while on his way east last week, gave the WESTERN ELECTRICIAN a call.

H. P. Bolles, of Aberdeen, Dak., was in the city recently investigating the merits of different electric lighting systems.

T. O. Terhune, general superintendent of machinery at the inter-state industrial exposition to be held in Chicago in the fall, is making arrangements to have the building lighted by the electric light.

Inadvertently, a statement that would create a wrong impression as to the residence of Col. Geo. L. Beetle appeared in a recent number of the WESTERN ELECTRICIAN. The genial colonel, in a casual chat with a representative, corrected the error and humorously explained that he resides in New York, lives in Chicago, and his place of business is anywhere in the United States.

W. H. McKinlock, secretary of the Central Electric company, Chicago, has returned from a successful western trip. He reports business very brisk.

Wm. D. MacQuesten, general manager of the Western Electric Construction company, of St. Louis and Kansas City, was in Chicago the early part of the week on business.

NEW ENTERPRISES.

Judge Creighton, of Springfield, Ill., is about to build a $5,000 residence.

Marshalltown, Ia., is to have a new opera house that will cost $25,000. It will be owned by a stock company. Dr. W. B. Kibby is chairman of the building committee.

At Dallas, Tex., a new cotton mill is to be built by the Dallas Cotton & Woolen mill company. About $100,000 will be expended. S. M. Blake is president of the company.

G. T. Bear is about to erect a residence to cost $6,000 at Kansas City, Mo. It will be fitted with electric appliances.

At Rockford, Ill., A. W. Keeney is to build a large mill for the manufacture of paper.

The new court house at Findlay, Hancock county, O., will cost about $100,000.

Fort Smith, Sebastian county, Ark., is also to have a new court house at a cost of $50,000. Wier, Hogg, & Byram of Kansas City, Mo., are the architects. At the same place a United States building for the accommodation of the United States court and post-office is to be erected. For the purpose $100,000 has been appropriated. The building will be lighted by the electric light.

At Stillwater, Minn, the C. M. & St. P. and C. St. P. M. & Omaha railroads are to build a union depot at a cost $140,000.

The Grand Opera House company of Fort Smith, Ark., will lay out $50,000 on a new opera house.

The Union Boiler works of Cleveland, O., will expend about $100,000 on a boiler works plant at Findlay, O.

Dallas, Tex., will expend $50,000 on a city hall and the Dallas club of the same place will lay out an equal amount on a club house.

A new hotel to cost $125,000 is to be built in Birmingham, Ala., by the Third avenue Hotel company.

J. C. Hubinger, of Keokuk, Iowa, is about to build a $12,000 residence which will be equipped with electric appliances and all modern conveniences.

The Ohio Coil & Cable Chain works company will erect a factory at Findlay, O., at a cost of $125,000.

A stock company is interested in a new opera house to cost $12,000, to be erected at Helena, Ark. B. J. Bartlett of Little Rock, Ark., is the architect.

J. J. & G. G. Vintrue of Findlay, O., will erect machine works at Findlay, O., at a cost of $75,000.

THE ELECTRIC MOTOR.

An electric railway is projected for Karlsbad, and a concession for this undertaking has already been obtained by a company from the minister of commerce.

The experiments made by the Union Electric company at Lykens coal mine, near Wilkesbarre, Penn., have been very successful. The loaded and empty coal cars in the mines are now propelled by electric motor instead of the old time mule or locomotive. Intelligent miners say that the use of electricity will thoroughly revolutionize mining in this country.

Among the companies recently incorporated in Illinois is the Union Passenger Railway company, of Chicago; capital stock, $1,000,000; to construct, maintain, and operate a horse, cable, electric, or steam railway, in the county of Cook; incorporators, James C. Page, Volna Parker, Sherman and Frank F. Douglass.

At a meeting of the common council of Rochester, N.Y., Tuesday evening, July 26th, a legal representative of the Rochester City Brighton Street Railway company announced that at the next meeting the company he appeared for would apply for permission to operate its existing lines as far as practicable, as well as those to be constructed hereafter, by the electric motor.

THE ELECTRIC LIGHT.

The town of Brussels in Belgium, has given the electric lighting of the Theatre de la Mannaie to Messrs. Gerard & Co., the contract being for £4,880 if the work is successfully accomplished. The contractors are to light the theatre with 250 16 candle power glow lamps, the current being produced at the municipal gas works about two miles distant, and being transmitted by means of Gerard's patent apparatus. At the theatre itself there will be a battery of ninety accumulators, capable of feeding the lamps, in case of accident, for five hours. Gadot's cells will probably be employed. In case of failure the contractors undertake to remove the entire installation without recompense. The lighting is to be ready by October 10th, and the installation is to be guaranteed up to the 1st January, 1889.

At Antwerp the Grand theatre and the Theatre Flamaud are to be lighted by electricity next season.

At the Schaerbeck-Brussels station, the receipts for the eight arc lamps which light the shunting yard amount to £720 this year. The railway management consider that the greater security and freedom from accidents afforded by the use of this light have resulted in a saving of £8,000. At the Grand Place de Brussels the two arcs have brought in £304, while the payment for lighting the Hotel de Ville has been £560.

Geo. M. Pullman, president of the Pullman Palace Car company proposes to introduce in this country the system now in vogue on one or two of the English railroads of storing electricity for the lighting of the cars from the friction of the car wheels. He has brought an expert over who will soon set to work on the series of experiments at the car shops at Pullman.

The Chicago Arc Light & Power Co. has removed its office temporarily to the building, corner Washington and Market streets, where preparations are making for the establishment of its electric lighting plant permanently. The room at present devoted to the office will shortly be taken up by dynamos and the office be driven to seek other quarters.

Messrs. Siemens & Halske will probably install a central electric lighting station at Graz. The central station at Salzburg and a great portion of the distributing plant are already finished, and it is expected that regular work will begin in August. The first trial run of the central electric light station in the Schenkenstrasse, in Vienna, was made with perfect success a few days ago. When this installation is in regular work it will bring up the total number of glow lamps running in Vienna and suburbs to 32,000.

The Compagnie Française d' Eclairage Electrique, have just inaugurated their station Drouot, the first central station for the supply of electricity erected in the heart of Paris. The present capacity is reckoned for 1500 lamps fixed, and the current is supplied by four compound wound Gramme machines, the distribution being on the three wire system for 100 volts Swan lamps of 10, 16 and 32 candle power. The pressure will be kept on the mains night and day, and a battery of 120 accumulators has been provided, in order that the machinery need not be kept running continuously. The Cauderay meters are employed, and the consumers will be charged according to the number of ampère-hours supplied. Motive power at the station is derived from two steam engines.

The Anglo-American Brush corporation, of Vienna, have taken the management of a local firm trading hitherto under the name of Kremenetzky Mayer & Co., and are very busy with private installations over a district extending from Trieste to Gorz, Styria, Nether Austria, Moravia and Bohemia. The firm are also doing some work in Russia. The electric light is rapidly being introduced in factories situated in Gablonz, Reichenberg, and other small towns in the north-eastern part of Bohemia. As regards central station lighting in large towns, very slow progress is being made.

The Beloit Electric Light and Telephone company, of Beloit, Kan., at a recent meeting of the city council of that place were given the exclusive right and franchise to establish, construct, maintain and operate an electric light plant and system in the said city of Beloit, for the purpose of lighting the streets, avenues, alleys, places of public travel, traffic, use and resort within the said city of Beloit, and for furnishing light for lighting public and private buildings, markets, places of business, hotels, boarding houses and dwelling houses, and such use of the streets and public grounds as may be necessary to construct and operate the plant, in accordance with conditions expressed in the ordinance. The company was also granted a franchise of similar nature to operate a telephone system. The electric lights are to be burning before January 1st next, and the telephone system to be in operation within a year.

THE TELEPHONE.

A Philadelphia syndicate is to introduce the telephone into China. The decree giving the syndicate the exclusive right to establish and operate lines in the Chinese empire was signed by the Chinese government a few days ago. The syndicate is headed by Wharton Barker and Li Hung Chang, the Chinese viceroy. The negotiations were transacted by Count Mitkiewicz, a Russian nobleman. The Chinese government takes one-half the stock of the company established by the decree. Work on the lines will be begun at once. The scheme embraces long distance communications between China's principal cities as well as local service.

A New York legislative committee is investigating the affairs of the various telephone companies of that state. The Central New York Telephone company, which has a capital of half a million and operates 1,400 telephones in Oneida, Onondaga, Madison, Lewis, Jefferson, St. Lawrence, Otsego, Herkimer, Hamilton, Delaware and Chenango counties, showed that since its organization it has paid dividends averaging 2 per cent. a year and placed $70,000 of its earnings in the construction account.

Wm. Hubbard, of Elgin, Ill., has resigned from the position of manager of the telephone exchanges. He will continue his general electrical business.

A dispatch from South Bend, Ind., says: "The common council of this city at its session this evening unanimously voted to have the Central Union Telephone wires and poles taken out of the city by Aug. 10 next. The cause was a demand of the telephone company that the subscribers sign contracts for a toll system which would cost more than the state law allows for rental, which is regarded as an evasion of the law. Over 160 of the subscribers refused and ordered their telephones out. There are now only about forty of the Bell telephones left in use."

Two years ago last month the law fixing the rental charges for a single telephone at $36 per annum went into effect in Indiana. Since then the telephone company has been operating at a positive loss in many places in that state. The legal advisers of the company were appealed to to devise some plan whereby the telephone company could observe the requirements of the law and get secure rental enough to enable them to do business—if not on a paying basis at least not at a loss. The toll system was devised, and in a friendly spirit was presented the subscribers of the South Bend exchange. There was no demand. The telephone company showed that it had observed the law and had lost money and stated that it could not do business any longer on that basis.

Experiments with electricity are often amusing. Sometimes they are expensive. Here is an example: One of the attendants in the central telephone office at El Paso, Tex., is Miss Belle Hepburn. Paul Keating, ex-mayor of El Paso, is proprietor of a saloon opposite the central telephone office. He had two rings hung from the awning in front of his house, and at just the height to tempt one to "try his muscle" by drawing himself up by them. Two invisible wires from the telephone office connected with the rings. When a man would come around the saloon he would be invited to seize the rings and draw himself up when the young ladies in the telephone office would turn on a current and charge the subject with electricity to such a degree that it would be impossible for him to let go until released by turning off the current. One day a man named Robbins was inveigled into takeing hold of the rings, when the charming Miss Hepburn turned on the current and fastened him to the rings. When he was released he had to treat the crowd in Keating's saloon. Robbins was so

severely shocked that he was laid up for a month or more, and he brought suit for $20,000. It bids fair to be a costly joke.

The New Orleans correspondent of the Chicago *Tribune* says: "Once every week the musical band of the Continental Guards gives a concert in Lafayette square, Frank L. Howard, a generous and wealthy citizen, paying the expenses. On music nights the square is crowded with women and children. Not to be outdone, the manager of the telephone company has fixed instruments over the music platform, and when the band plays he switches on his instruments so that music is heard not only in hundreds of city residences, but on plantations up and down the river and hundreds of miles in the interior."

The Toronto *Globe* of a recent date says: "The city clerk has received a letter from G. R. R. Cockburn, M. P., stating that the minister of public works has assured him that the petition of the Toronto city council to compel all telephone, telegraph and other companies to lay their wires underground was passed to the council, and that after due examination an order in council on the subject was passed, which will be at once transmitted to the proper authorities. No legislation on the question can be passed this session, the letter states, especially in view of the fact that there has been little or no demand made to the government on this subject, and that the city itself must surely possess the power to deal with the matter."

THE TELEGRAPH.

Assistant-Secretary Thompson and Superintendent Kimball of the life saving service, treasury department, have begun an extended tour of inspection of the custom houses and life saving stations along the Canadian frontier. While on this tour they will also look into the feasibility of establishing a telegraph system in connection with life saving stations, as authorized by congress.

A singular grievance suffered at the hands of the Western Union Telegraph company by a number of young ladies has brought forth a lawsuit for damages. It appears from the papers filed in court at Topeka, that sixteen young ladies sue the Western Union Telegraph company for $300 damages each. The complaint states that owing to the failure on the part of the company to deliver a message, which was to have been sent from Valley Falls to Nortonville in February last, the young ladies were obliged to walk eight miles to reach the village of Perdue, where they were to give an entertainment for the benefit of their church. They were lost and wandered around over the prairie from six o'clock in the evening until two o'clock the next morning. Each suit is separate but they will all be tried together.

It is said that the longest span of wire in the world is used for a telegraph line in India, over the river Kistnan, between Bezorah and Sectyna-Grum. It is more than 6,000 feet in length, and 1,200 feet high.

By the crossing of two telegraph wires sparks were produced which set fire to a telegraph pole in John street, opposite the Western Union building, in New York, recently. There were about 150 wires hung on the pole. An alarm of fire was sounded, and soon engines arrived and the pole was saved. The flames were near the top, and it was with some difficulty that water could be raised to such a height; but at last the effort was successful and the flames were overcome.

There is some talk of extending the Baltimore & Ohio telegraph line to Shreveport, La.

There are a score of men in New York who are paid as much for their services each year as the president of the United States. Forty thousand dollars a year is a very tidy salary. There are hundreds of men who get $25,000 a year salary, and the number who get from $10,000 to $20,000 is legion. Very ordinary men get from $5,000 to $8,000 a year, or as much as a cabinet officer. Dr. Norvin Green, president of the Western Union Telegraph company, is paid $50,000. So is Chauncey M. Depew, president of the New York Central railroad. Richard M. McCurdy, president of the Mutual Life Insurance company, gets a like amount. John Hoey, president of the Adams Express company, fares equally as well. President Henry B. Hyde, of the Equitable Life Insurance company, is also in the list. George G. Williams, president of the Chemical National bank, the richest banking institution in America, with nearly $5,000,000 of surplus, $20,000,000 average deposits, is paid a salary of $25,000 yearly. President Potts, of Park bank, and President Tappan, of the Gallatin National bank, receive a like sum each twelve months.

Recently the telegraph operator of the Santa Fe railroad at Pendleton noticed the suspicious actions of eight strange men who were loitering about the station, and suspecting that a train robbery was planned, wired a train dispatcher at Temple just in time to stop the Kansas City through express at that point. An armed posse was taken aboard, and the train proceeded northward. Half-way between Pendleton and Temple an obstruction was encountered, and no sooner had the train stopped than six men attempted to board it. The posse opened fire, and one of the would-be robbers fell. The others, taking their wounded companion, hurriedly fled to the woods.

Miscellaneous Notes.

An official order has been issued by the Chicago & Northwestern railway company requiring superintendents, train-dispatchers, conductors, firemen and yardmasters to have their watches examined every three months as to quality and condition. The order took effect August 1st, and a certificate of examination, signed by examiners appointed for that purpose, will be required. The order stipulates that all watches must be fifteen jeweled, patent regulator, adjusted to heat and cold and protected with the anti-magnetic shield.

A jeweler in Lynn, Mass., has been arrested charged with a novel crime. It is alleged that he has stolen large quantities of electricity from the local telephone exchange. It seems, as the dispatches state, that the jeweler had obtained some telephones formerly used by a local inventor and had run an independent exchange of his own, tapping the wires of the regular exchange for his supply of electricity. The accused denies running an independent exchange but admits that he tapped the wires of the telephone company.

An attempt is being made to form a national association of water gas engineers and superintendents. Pending a permanent organization, E. C. Brown, 333 Walnut street, Philadelphia, Pa., has consented to act as temporary secretary.

"As the electric light came to break the power of exclusive gas franchises so the artesian well has come to render our citizens independent of exclusive water rights," concludes the New Orleans *Picayune* after congratulating the citizens of that place on the prospect of an abundance of pure water from artesian wells instead of the muddy stuff by virtue of fluidity denominated water and supplied from the Mississippi river by a water company holding exclusive privileges.

Manager Daniel Frohman of the Lyceum theatre, New York, and E. H. Sothern, his young star do not believe in the tradition that the average messenger boy is as slow as a snail, and determined on a novel plan to test a boy's capabilities. They have sent a messenger to London to carry congratulatory letters to Madison Morton and Robert Reece the surviving authors of "The Highest Bidder" and also souvenirs to English resident and American visiting actors and actresses. The messenger is to deliver each of these personally, get his ticket signed, and then return home at once, just as he would do in district telegraph service at home. The boy selected was not over fourteen years old. He was given a new uniform and something extra to keep him from loitering on the way—probably on the ocean voyage. Mr. Frohman is now willing to wager that the messenger boy will do the work assigned him, that he will not get run over or drowned, and that he will arrive home just as quickly as any one else under the circumstances.

During a thunderstorm at Hazelton, Pa., lightning struck a penknife in the hands of High Sheriff Zierdt, who was bathing in a tub. When he recovered consciousness he found nothing but small splinters of the tub he had been bathing in, and the water it contained was equally distributed over the floor, as if done with a mop in the hands of a scrub-woman The metal in the knife was melted. No other evidence that the lightning had entered the room could be found.

The Pacific Julien Electric Company has filed articles of incorporation to engage in the business of electricians at San Francisco; to build, buy, lease, acquire and deal in any and all inventions, improvements of every nature and all kinds of appliances connected with electricity in any and all its forms. The period of the corporation's existence is fifty years, and the directors are: Irwin C. Stump, James H. Dobinson, H. B. Land of Oakland, E. W. Lesser of Sausalito and Fred M. Pickering. The capital stock is $1,000,000, divided into 10,000 shares of $100 each.

There was a total of 270 fire alarms in Chicago last month—an average of a little less than nine a day.

"Bob" Watson, who as manager of the American district messenger service in Detroit trained the boys down from a 10-minute gait to a 2:20 trot, has established a similar service in East Saginaw. "Bob's" call boxes give subscribers a choice of ten calls by signal, the boxes ordinarily in use giving but four. A night watch signal system is contemplated, similar to that in vogue in Detroit and other large cities. The service already has 75 subscribers. It is owned by a stock company.

S. Pitt, of Sutton, Surrey, England, has invented an electro-dynamometer for registering the number of watts. It consists of two annular bobbins, one pivoted or suspended inside the other. The outer bobbin is fixed, and is composed of two parallel and similar coils of metal ribbon or tape. The inner bobbin is wound with fine wire, having a resistance of about one thousand ohms, and forms a shunt on the main circuit. The indicating needle, which is attached to the pivot of the moving coil, oscillates over a scale secured to a movable frame, and has attached to its extremity a piece of bronze which comes in contact with the teeth on the cylinder as the latter rotates, and lifts the movable frame, and this actuates a ratchet wheel which controls the train of wheels in the registering device. The toothed cylinder making one turn a minute is rotated by clock work driven by an electromotor composed of four fixed bobbins and a rotating armature.

Business Mention.

The Schultz Belting Co. have taken orders recently for belting two large oil mills in the south, and also an electric light plant in Pittsburgh. The company has ordered a large power belt press 62 inches wide, and can now make belts of that width.

The Edison Electric Illuminating company of Rochester, N. Y., has found it necessary to increase its facilities, and has awarded the Woodbury Engine company of the same city a contract for furnishing two tubular boilers of 150 horse-power each, one of the company's new high speed automatic cut-off engines, of sixteen inches bore and twenty inches stroke, which can be run at a speed of 200 revolutions per minute, and one of its girder style of side-valve engines, of sixteen inches bore and twenty-four inches stroke, having a speed of 150 revolutions per minute. The latter engine is to be regulated by a Judson governor. Each engine can easily afford 150 horse-power. The high speed engine mentioned is to be of the style described and illustrated in the first number of the WESTERN ELECTRICIAN. This engine is remarkable for its close regulation, and hence is well adapted to electric light plants.

Edw. P. Allis & Co., of Milwaukee, Wis., have just issued a neat illustrated catalogue of a handy size, showing pulleys, gearing and hangers of their manufacture. In addition, the catalogue contains much valuable information in the form of tables that are very convenient for reference.

The cable department of the Western Electric company, Chicago, is crowded with work. Last week 5,600 feet of 110-wire cable to be laid in New York in the 6th avenue conduit, between 39th and 58th streets, was completed. This is a duplicate of one of the cables laid there last winter. Work has been begun on 200-wire underground cables for the Chicago Telephone Co., aggregating about 500 miles of wire. These cables are to be drawn into the iron pipes recently laid from LaSalle street through Calhoun place to

their new building corner of Franklin and Washington streets. Orders have also been received from the New England Co. for about three miles of 50 and 100-wire cables to go under ground in Boston. One of these, 100 wires, 7,200 feet in length, will have probably the lowest static capacity of any telephone cable ever made. The core containing 100 No. 18 conductors is to be one and one-half inches in diameter, the ordinary size being about one inch.

Attorney F. C. McMillin, of Cleveland, has been appointed receiver of the United Carbon companies.

The Schenectady Gas Light company, of Schenectady, N. Y., have ordered, through C. L. Levèy, of 61 Broadway, New York, another 35-light plant of the American system of arc lights.

The Gas Lighting Co. of Stevens' Point, Wis, has ordered a 60-light arc plant of the Western Electric Co., of Chicago.

The Electrical Supply Co., Chicago, have the agency for the standard carbons, manufactured at Cleveland, Ohio, and will keep a large stock of all kinds and sizes.

The Edison company, of Oskaloosa, have taken a contract for lighting the city by the Edison system, and will use 167 lamps; those in the central portion of the place will be 32 candle power and those in the outskirts 16 candle power. These lamps replace arc lights and gas. Edison incandescent lamps will be used exclusively. The street system is to be installed by Leonard & Izard, of Chicago. The same firm is installing a plant of 100 lamps for the Edison company at St. Mary's seminary at Faribault, Minn.

The Jarvis Engineering company's western office, 81 Lake street, Chicago, has sold in the week past twenty-three Jarvis patent furnaces to parties in St. Paul and Minneapolis. One order was for eleven furnaces and the remainder of the total was made up of orders for one or two furnaces.

The Pittsburg Carbon Co., Lim., of Pittsburg, Pa., has sold its plant and entire business to the Faraday Carbon Co., of the same city. Additional capital has been put in and the plant has been enlarged. The business will be run under the same management as formerly.

The Heisler system of long distance incandescent lighting at St. Louis is giving eminent satisfaction. The central station is located at Second and Gratiot avenues, and some of the lights are on circuits ten or twelve miles long; yet it is noticeable that two lamps of equal candle power, one in the station and the other a half dozen miles away, possess a wonderful uniformity in brilliance of illumination.

The *Tribune* of this city, slow, conservative but sure in commercial matters, said on Tuesday last, "Many of the shrewdest and best business men in other branches of trade and manufacture, as well as the principal capitalists of the money centers, I find are investing largely in electric manufacturing. Numbers of those who were pioneers in the business from honest convictions of its importance or clear foresight of its future have grown suddenly rich through it. Notable are the cases of Thomas A. Edison, Brush, of the Brush company; Goff, of the American company; Gilbert, of the Boston, and scores of their associates. All of those named began in the business as poor men and all are now known to be wealthy. I am told that Goff, of the American company, holds more stock in different electrical enterprises in various parts of the country than any other man in the United States. His surroundings in the new Telephone building, at 18 Cortlandt street, certainly indicate great prosperity. Goff deserves success, for he has been among the boldest, most untiring and most enthusiastic worker in the new business. His income from the electric light business is estimated at not less than $75,000 a year. I have little doubt that when Goff's favorite policy of combining gas and electric lighting is finally accepted by all the companies, gas and electric light securities will be ranked as among the most popular and best paying of investments." Just why the *Tribune* should have omitted the names of such other successful men who have made or are making millions out of electric lighting as Theodore N. Vail, Dr. Alexander Bell, Hubbell Westinghouse and others I cannot understand, says the New York correspondent of the *Chicago Herald*. Governor Gordon, of Georgia, and ex-Governor Charles Foster, of Ohio, are two of the new investors in this particular line; they are in the American Electric company, of this city. Over one hundred gas companies have adopted the system suggested by this company, which combines gas and electric lighting from a common plant.

Electrical Patents.

Issued July 26th, 1887.

367,042. Acoustic Telegraph. John H. Irwin, Philadelphia, Pa. The invention relates to carbon telephone transmitters. The induction coil and electrodes are included in the same case. Two diaphragms are shown with an air space between them. The outer one carries the carbon electrode and the other, carrying the metallic electrode, serves as the contact spring.

367,069. Electric Locomotive. Edward S. Shaw, Cambridge, Mass. The invention relates to the mechanical connection of the electro-motor with the driving wheels of a bogie or pivoted truck. The motor is placed above the floor, and the power applied uniformly to all the driving wheels, leaving them free to move vertically in their spring bearings.

367,080. Armature for Dynamo Electric Machine. Merle J. Wightman and Oscar Urban, Hartford, Conn. The coils of a drum armature are shown separated at the ends, to form air spaces for ventilation

367,081. Dash-Pots for Arc Lamps. Merle J. Wightman and Hermann Lemp, Hartford, Conn.

367,082. Switch and Automatic Cut-Out. Merle J. Wightman and Hermann Lemp, Hartford, Conn. This switch is operated by an electro-magnet included in a shunt around a group of lamps. The novelty consists in the lever mechanism.

367,164. Insulator. Henry K. Ruger, Bay St. Louis, Miss.

367,205. Electric-Test System. Joseph W. Frost, Rochester, N. Y. The invention is shown in connection with a closed system of fire alarm circuits. By means of switches the inspector may test the circuits and apparatus.

367,219. System of Telephonic-Intercommunication. John A. McCoy, Medford, Mass. An indicator at each subscriber's station working in unison with a dial at the central station shows when connection can be made with any particular line. The system is designed for exchanges too small to support an operator.

367,241. Means for Connecting Engines and Dynamos. Adolphus W. Schleicher, Philadelphia, Pa.

367,244. Apparatus for Applying the Expansive Power of Heat. William C. Shaffer, Chicago, Ill. The invention may be used for the purpose of closing or opening an electric fire alarm circuit.

367,270. Electrically Actuated Vibrator. Frank B. Colman, New York, N. Y. The tension of the vibrator is adjusted by a yielding tension device.

367,294. Galvanic Battery. Henry I. Harris, Islington, Middlesex, England. The invention relates to sealing batteries of the Bunsen type. As such batteries must not be sealed, when in use, the utility of the invention is not apparent.

367,323. Fire Extinguisher. Charles H. Shaffer, Rockford, Ill.

367,332. Means for Individually Controlling a number of Devices by Electricity. Channing Baxter, Brooklyn, N. Y. The invention consists in controlling a series of devices individually by different combinations of electro-magnets in pairs. Five electro-magnets may thus control ten annunciator drops.

367,341. Electric Smelling Bottle. Lloyd B. Fuller, Chicago, Ill.

367,348. Lightning-Rod Brace. L. Lavake Mast, West Milton, Ohio.

367,350. Apparatus for Extinguishing Fires on Railroad Trains. James F. McLaughlin, Philadelphia, Pa.

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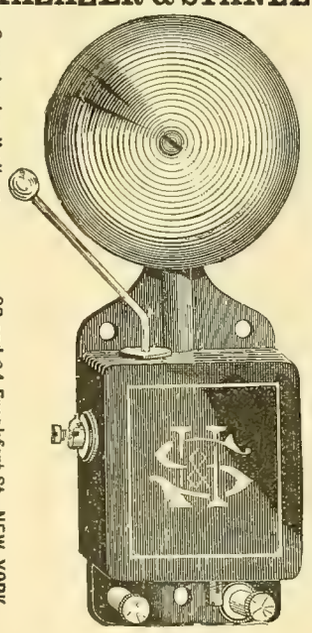

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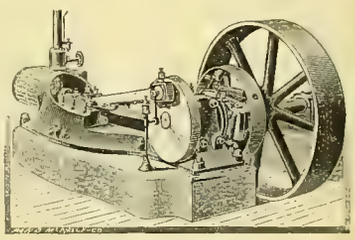

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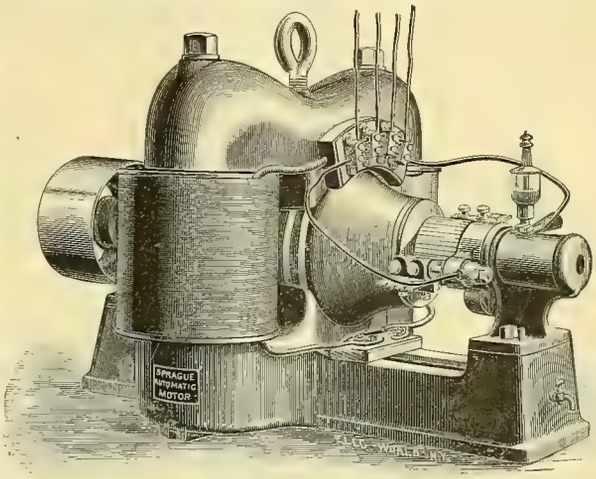

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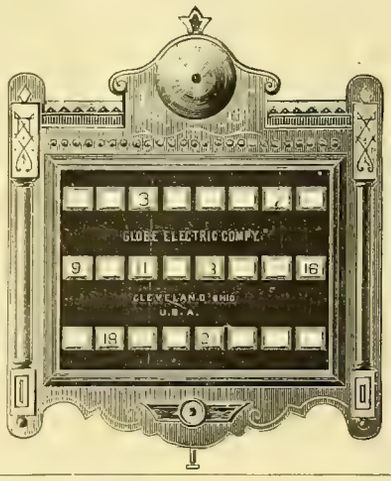

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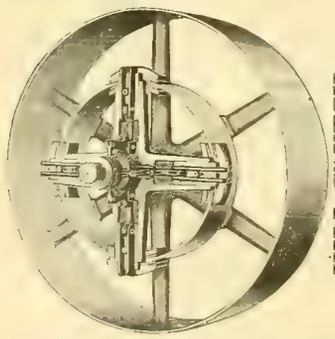

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THE POROUS CELL ALSO BEARS LABEL.

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Every Jar and Porous Cell bears the label and trade mark as shown in the cut. All others are imitations.

Do not be Imposed Upon.

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NONE OF THE IMITATIONS COMPARE WITH IT IN EFFICIENCY.

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149 West 18th Street, - NEW YORK.

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ILLUMINATING COMPANIES proposing an extension of their Incandescent Plants are invited to correspond with the undersigned before commencing Construction. With our recent improvements and reductions in price the cost of placing large Incandescent Cables underground in a solid and substantial manner is brought within actual business limits.

THE CALLENDER COMPANY have, during the last two years, laid many miles of large Cables underground, all of which are in actual work. Almost every inch of the Underground Incandescent Work, both in this Country and in Europe has been laid on the Callender plan. The difference in cost between an overhead and underground system for Incandescent work is now no greater than is warranted by the better service insured by an underground system. The Callender Company's Underground Incandescent Cables and System have been in actual operation for some two years in twelve cities, and are endorsed by all the parent light companies.

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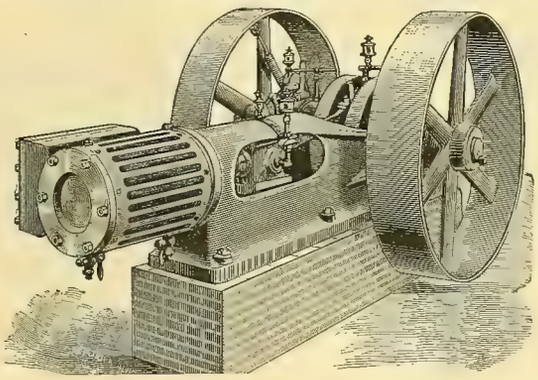

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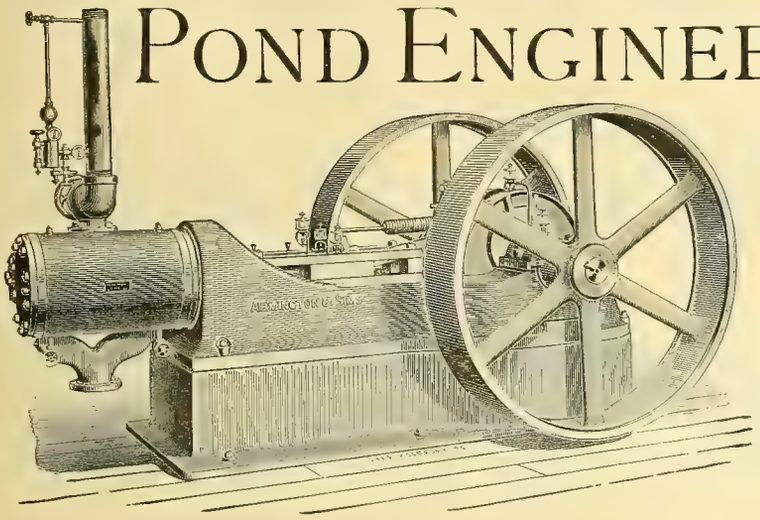

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Motors Wound for any Current, Arc or Incandescent,

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Regulation Superior to any Motor.

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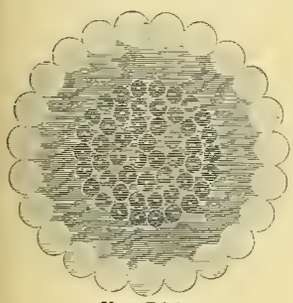
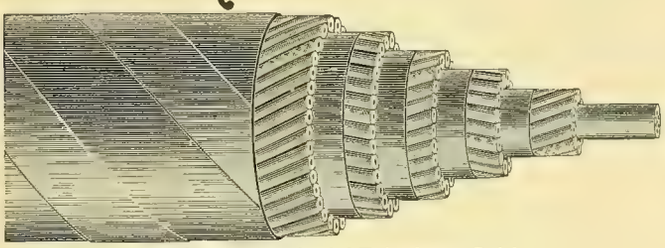
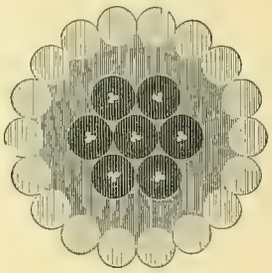


No. 500.
50-Conductor Submarine Cable.
Conductors, each No. 20.
Insulation, 3-32.
Armor, 23 No. 6.



100 Conductor Aerial Telephone Cable.
Conductors, each No. 20.
Insulation, 3-32.



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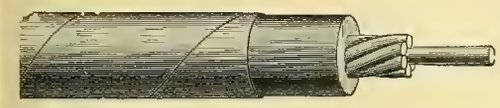
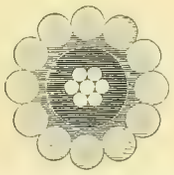
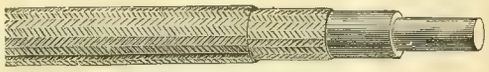
Aerial Use, Subterranean Use, Submarine Use, Concealed Wiring in all Locations.



Underground Electric Light Wire.
6 No. 14 and 1 No. 13. Insulation, 16-32.



Armored Electric Light Cable.
6 No. 14 and 1 No. 13. Insulation, 16-32. Armor, 12 No. 6.



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4-32 Insulation. Plain.

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Incandescent and Arc Light Apparatus.

Claiming Superiority over other Systems

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Perfection of Automatic Regulation.
Durability of Lamps.
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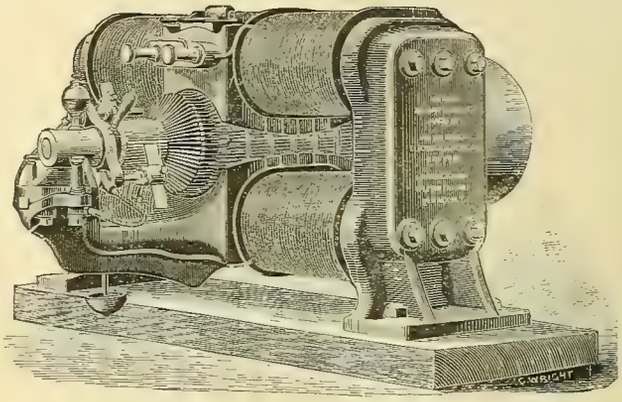

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The only system offering reasonably low cost for main conductors combined with economy in operation, that has been subjected to a commercial test for any length of time.

ITS CLAIMS ARE

GREAT SIMPLICITY.
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THAT IT CAN BE DISTRIBUTED MORE WIDELY.
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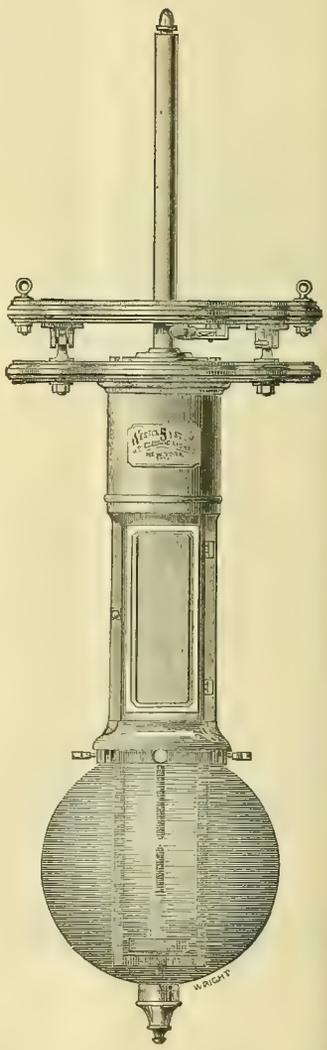

Compare our guarantees of the following SIX most important points in incandescent lighting with the guarantees of any other Company.

1st.	Number of 16 Candle Power Lamps to the Horse Power,	10
2nd.	" " 20 " " " " "	8
3rd.	Life " 16 " " " guaranteed,	600 hours.
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ELECTRIC RAILWAY APPARATUS,

Electric Arc Light Dynamos and Lamps.

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OUR

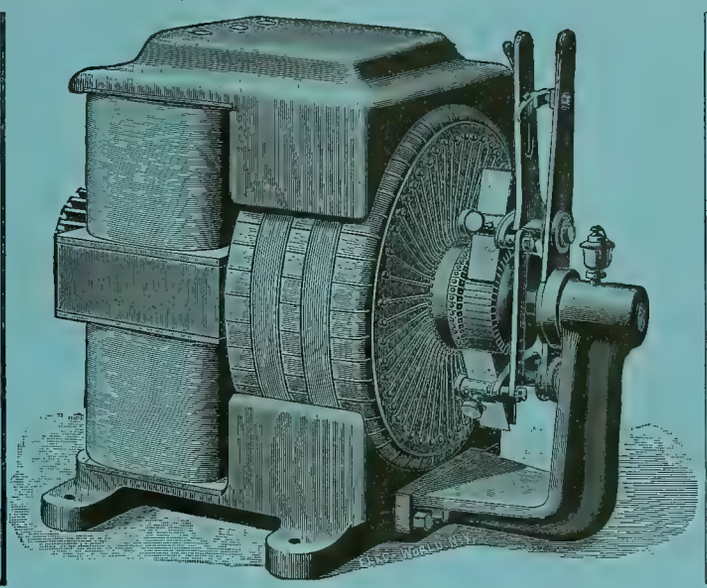
Arc Electric Light

UNEQUALED.

The Only Perfect Double-Lamp.

THOUSANDS IN USE.

Guaranteed equal to any in every respect.



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The Overhead Wire and Underground Conduit Systems Fully Protected.

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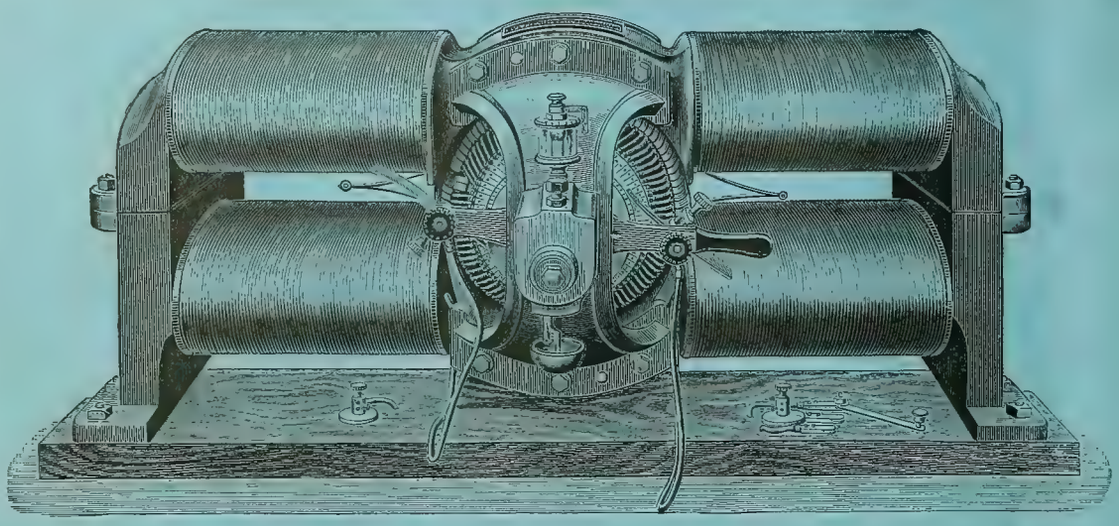

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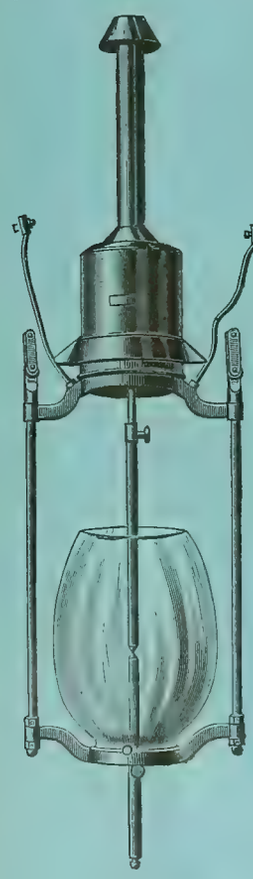
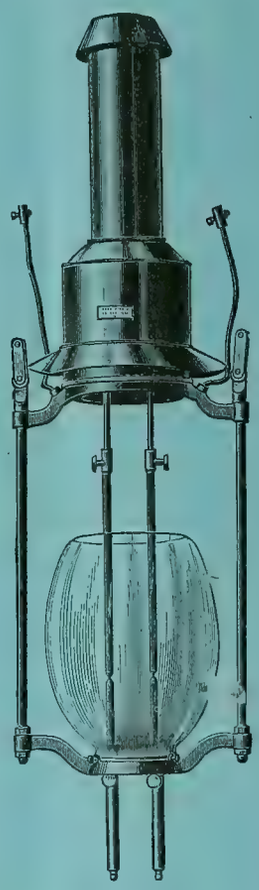


—AND THE—

Perfectly Automatic and Self-Regulating

JENNEY ARC LIGHT



The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

ONLY GOLD MEDAL

At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

This system HAS NO EQUAL for SIMPLICITY, DURABILITY and STRENGTH OF LIGHT.

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COMPLETE INCANDESCENT SYSTEM.

DYNAMO: PERFECTLY AUTOMATIC, SHUNT WOUND, REQUIRING NO RESISTANCE for variable load.

LAMP: NEW FILAMENT, NEW PRINCIPLE of Construction, REMARKABLE LENGTH OF LIFE with FULL CANDLE POWER, will not deposit carbon on inner surface of bulb.

The filament is as pliable as a piece of thread and is not made brittle by the action of the current.

Complete System of Fixtures and Attachments, also full line of Electroliers, Combination Fixtures and Shades.

We are in the market for Large Incandescent Contracts.

ELECTRIC MOTORS

We have the Only Perfect Working Headlight for Steamboats, with Focusing Reflector. Full information furnished on application.

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Western Electrician.

EVERY SATURDAY.

Vol. I. CHICAGO, AUGUST 13, 1887. No. 7.

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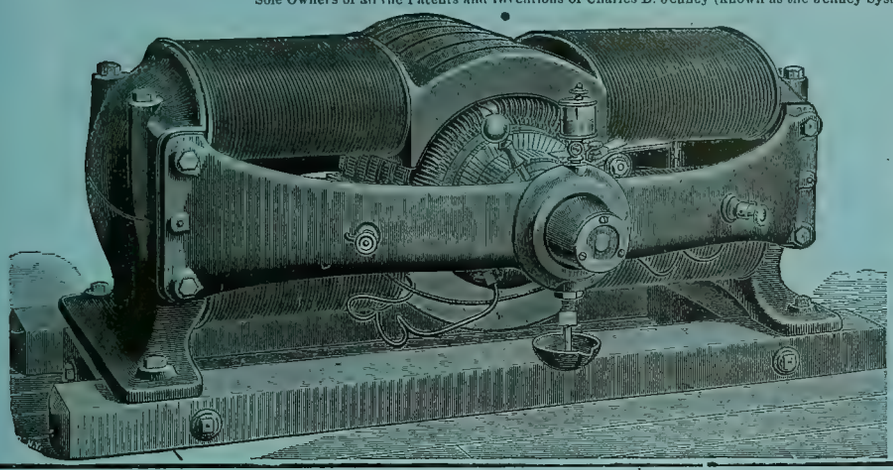

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In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

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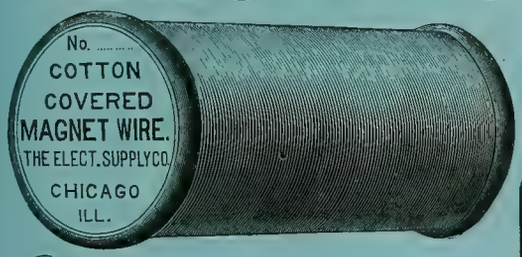
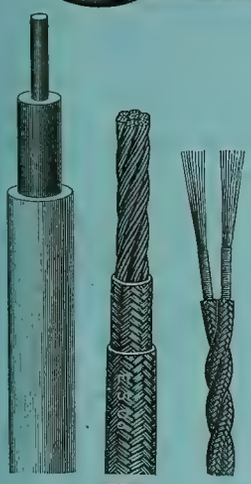


FINE COTTON and SILK COVERED

Magnet Wire.



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CONDUCTOR CORDS.

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FACTORIES, ANSONIA, CONN. 17 DEY STREET, NEW YORK.

The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

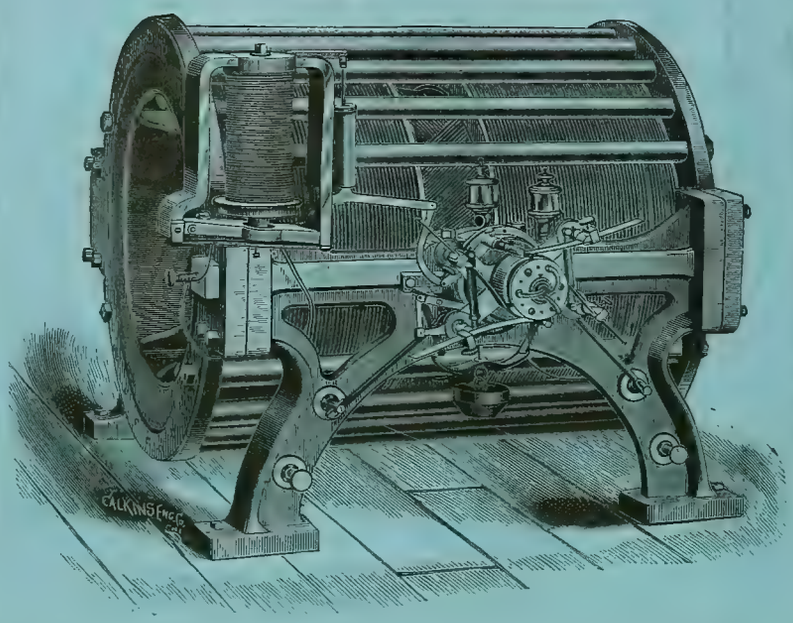
OF

Electric Arc-Lighting

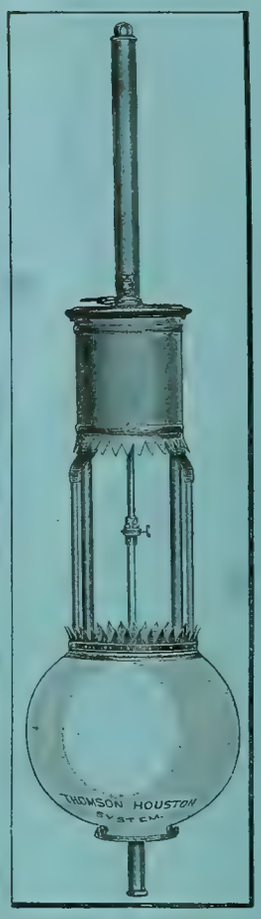
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

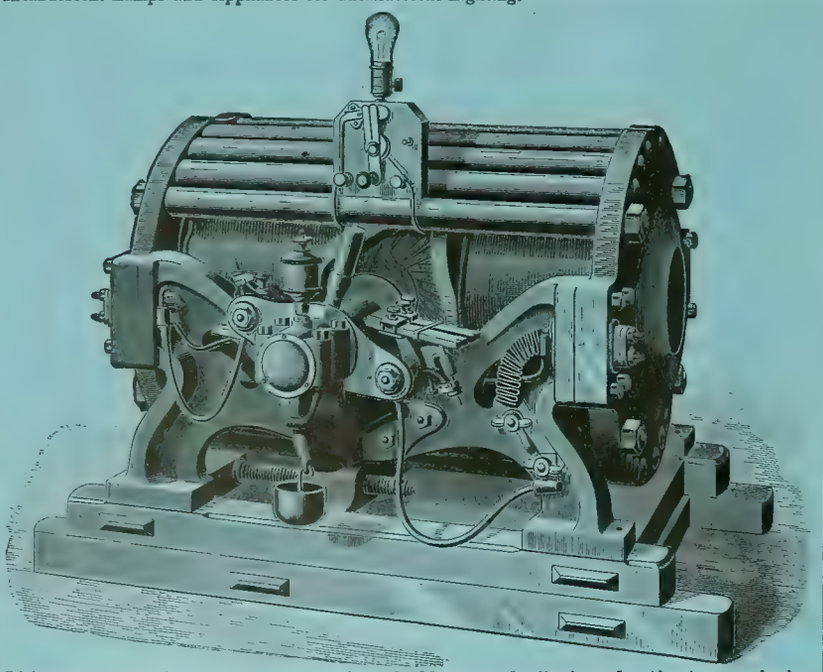


This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.



This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

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Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufg. Co.

18 Cortlandt Street, NEW YORK.

For Simplicity of Construction, Steadiness and Purity of Light, Perfection of Automatic Regulation, Economy of Power in Operation, Freedom from getting out of Order, and Absolute Safety of Armatures from Burning,

THE AMERICAN DYNAMO HAS NO EQUAL

INTENDING PURCHASERS,

Whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

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REYNOLDS' IMPROVED CORLISS.

THE IDEAL ENGINE FOR ELECTRIC LIGHT WORK.

Unequaled for Close Regulation

—AND—

ECONOMY OF FUEL.

Write for our Catalogue and Circular giving List of Users.

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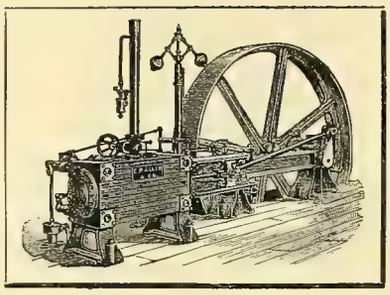

We refer to the following electric light plants now using the Reynolds' Corliss:
Brush Electric Light and Power Co., Cleveland, O.
Edison Electric Light and Power Co., Rockford, Ill.
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Badger Illuminating Co., Milwaukee, Wis., two engines.
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Louisville Electric Light Co., Louisville, Ky.
La Crosse Brush Electric Light and Power Co., La Crosse, Wis.
C., M. & St. P. R. R., Milwaukee, Wis.
Menominee Mining Co., Iron Mountain, Mich.
West Hotel, Minneapolis, Minn.
Plankinton House, Milwaukee, Wis.
N. W. Mutual Life Insurance Co., Milwaukee, Wis.
J. V. Farwell & Co., Chicago, Ill.
Chas. H. Slack, Chicago, Ill.
Mandel Brothers, Chicago, Ill.
C. Boetcher, Leadville, Col.
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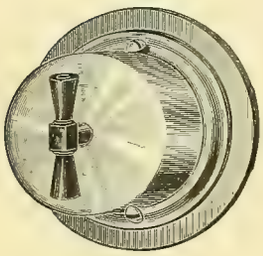

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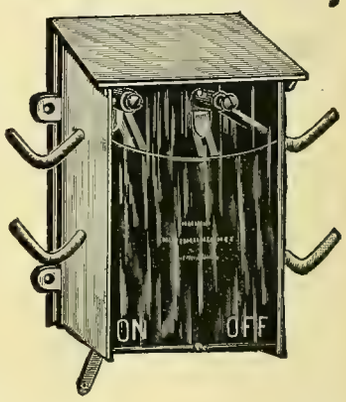

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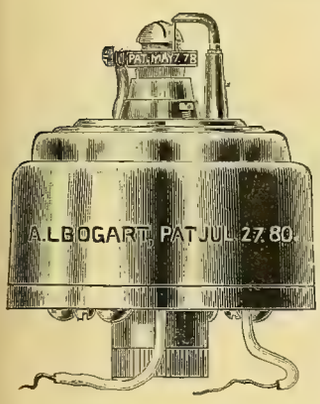

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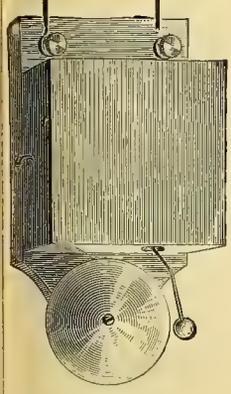

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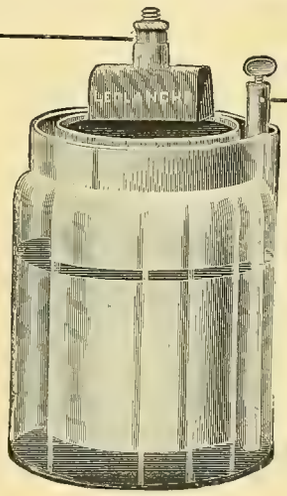

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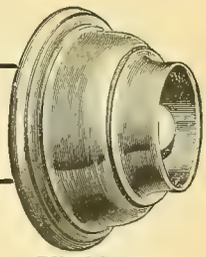

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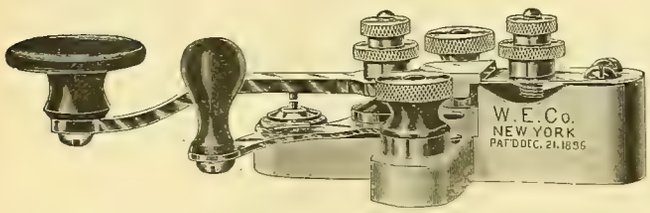

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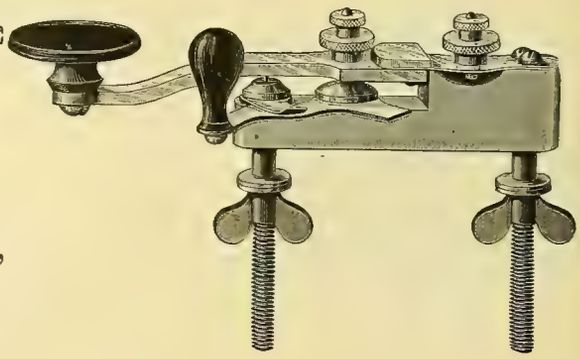

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Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, AUGUST 13, 1887. No. 7.

Allegheny County Light Co.'s New Station.

The old station of this company occupied a space of 35 feet by 83 feet. It was two stories high, was an old rickety tumble-down soap factory before it was used for an electric light station, and was in no way adapted for a central lighting station. The location, however, was central, and the company made the best use it could of the property, taking the ground floor for an engine and boiler house, and trussing the second story for dynamo purposes. There the business was carried on, extending from time to time until June, 1886, when the company, having purchased the adjoining property, began tearing down the old building and erecting its present station. Rapid progress was made until at length the new station was complete, surrounding and covering the old one. The new building is 96 feet by 83 feet, and 74 feet high in four stories. The walls are 22 inches thick, and the interior of the building is of wrought iron, capable of carrying the heaviest dynamos and engines, set as close together as practicable.

The boiler house is 30 feet by 62 feet, and contains at present three water tube boilers of 360 horse power each, nominally.

The engine room is 43 feet by 59 feet, and 26 feet in height; taking in, as will be seen from the cut, the entire height of the old station, the original dynamo floor of which can be seen in the centre of the present engine room. There are two 500 horse power Wetherell–Corliss engines, driving two shafts on the dynamo floor above, and as soon as the old small engines can be taken out, they will be replaced by three 200 horse-power Westinghouse engines, driving direct dynamos on the floor above.

The dynamo floor in the second story is 96 feet by 83 feet, and is at present a heterogeneous mass of Brush arc machines, Westinghouse direct current incandescents, and in one corner, which is really the only completed part, four alternate current dynamos of 1,300 lights capacity each. These are the machines shown in the cut. They are driven by one of the large 500 horse power engines, and arrangements are being made for two 2,500 sixteen-candle power alternate current dynamos to be driven direct from two of the 200 horse power Westinghouse engines below. While this floor will be a very large one, there will always be a want of uniformity about it, as the station and business were laid out for the Brush arc, and the Westinghouse incandescent direct current machines, and the change to the alternate current system involves such changes in driving arrangements as to seriously interfere with the original plans. The company's new station in Allegheny City, however, is to be one of the finest in the country, as it started there with a bare lot, and put the building up to suit itself. The third floor is at present used only for a wire room, where all the circuits come in through the front of the building, and are distributed to the various switch-boards and machines, but it will no doubt eventually be used for generating machinery too.

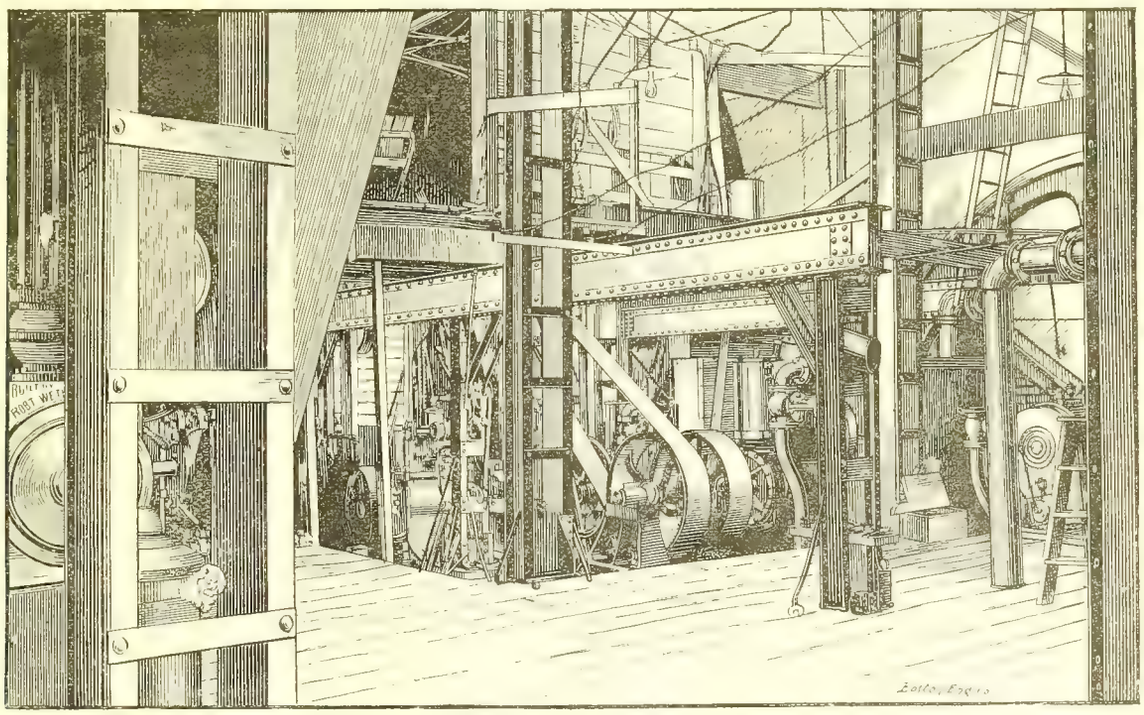
The fourth floor contains the store room, the linemen's work room, and the repair shop. The store room is fitted up with wire racks for the reels, by which the storekeeper can tell at a glance what kind of wire, and how much wire he has in stock; and on one side are a series of cupboards with glass fronts, to carry the stock of incandescent lamps, for which cupboards are so arranged that of the 10,000 lamps carried in stock every separate one can be seen and removed without touching the others.

The offices of the company are on the ground floor, and take a space of 15 feet by 40 feet out of the engine room. The indications are that it will not be long before the company will find it necessary to remove its offices down town, and put boilers and engines in the room that it now occupies. The present plans for the station, and the machinery already ordered and in the course of erection, provide for 500 arc lights, and 20,000 incandescents, with the ability to double this if necessary.

During the entire progress of the work of transformation, not a single light was at any time turned off, or cut out, in making the necessary change of boiler power, engine power, or wires. Only those who have been through or superintended such a change can realize the amount of labor and responsibility it involves.

When this new station with a capacity of 30,000 lights, the South side station with a capacity of 3,000 lights, and the East end station with a capacity of 20,000 lights, are all finished, we think that the fate of gas as an illuminant will be sealed in Pittsburg.

One of the interesting features of the station is the arrangement of natural gas connections in the boiler house, by which the fireman has by means of regulated valves almost automatic control of the steam power. Should a change be required from gas to coal, the settings are so arranged that the change could be made from gas to coal in three minutes.



Allegheny County Light Company's New Station.

Revolutionizing Railway Systems.

J. W. Stoker, of Kansas City, has just thrown upon the world an invention that is calculated to entirely revolutionize railroading, by doing away with steam and putting electricity in its place. It is said that a train carrying all of Mr. Stoker's patents would be a moving stream of electricity, a circuit on wheels, says an Omaha paper, and the inventor is confident that it will be but a few years until all the railroads in the country will have adopted his patents. He has had no trouble in organizing a company of Kansas City capital-

ists, who are of his opinion and who have organized and taken $1,000,000 of stock in the patents. The railway train of the future will be propelled by electricity, of course, and the inventor, to hasten the change from the old to the new method, has arranged his electrical contrivance so that it can be applied to the locomotive of today. The tender will be replaced by an electrical storage battery car, about one-half as large as an express car. The electricity generated by the battery will supply an electric motor in the engine. The motor operates compressed air pumps which force the air into the boiler and run the engine with cold air instead of steam. This does away with fuel and water, smoke and cinders. Having furnished the power the inventor has turned his attention to the train itself. A very neat little contrivance, called by the inventor an electric conductor and air-brake coupler combined, provides connection for the electric wires which are run through the train, by connecting the tube which contains them with the air-brake tube. The coupler makes the connection for both as simply as though they were but one tube.

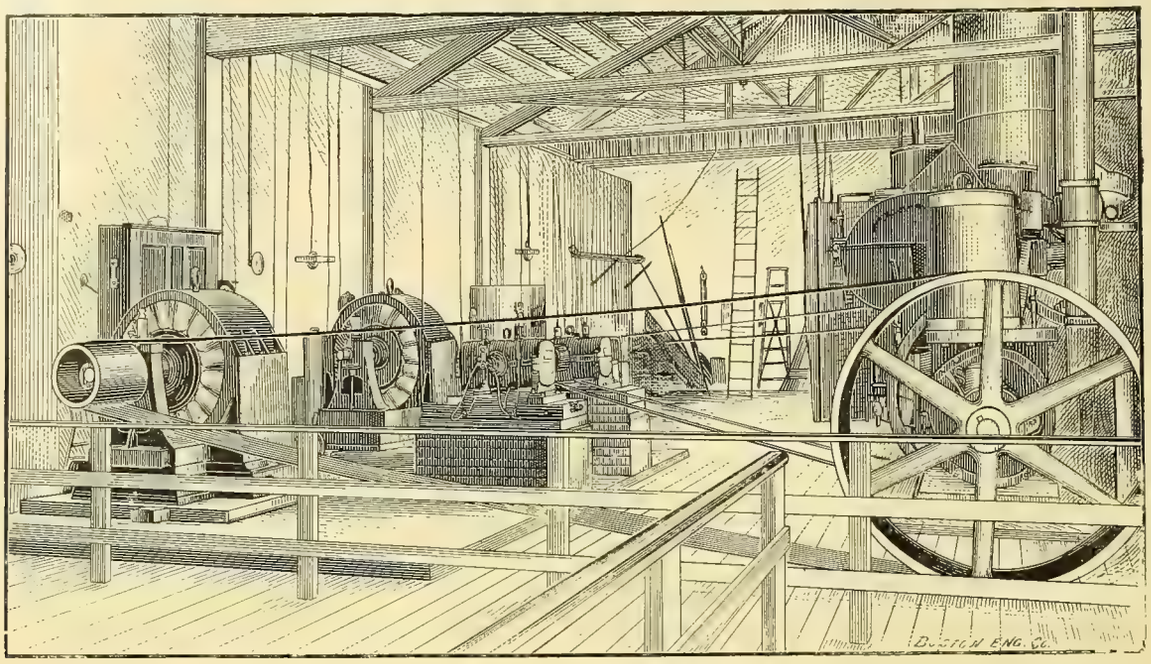
Mr. Stoker is now at work upon an invention that he expects will entirely supplant the Westinghouse air brake. This is an electro-automatic air brake, constructed upon an entirely different plan from that of the Westinghouse. By means of it the pressing of an electric button in the cab of the engine will stop the train at once. The bell cord will be done away with by another invention, and the grasping of a wooden handle or the touch of an electrical button will blow a whistle in every car in the train and the engine.

There will be no further trouble with the brakeman who calls out the names of the stations in an unintelligible gibberish. In the end of each car will be a sign. At the side of the track at each station will be a post, at the foot of which will be planted an electric battery. An arm from this post will reach out so as to touch each car as it passes, and when it touches the car, an electric circuit will be closed, and the card bearing the name of the previous station will drop, giving place to the one bearing the name of the next.

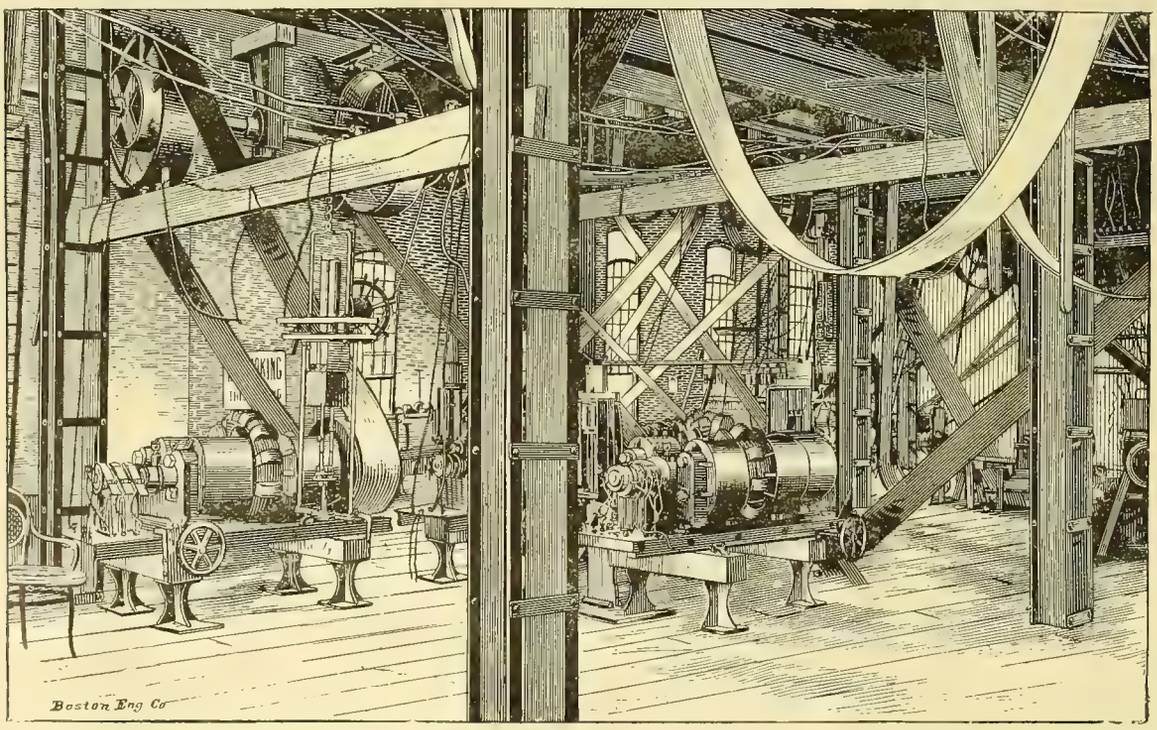
Another electrical device that the train of the future will carry, will be a contrivance to prevent the wheels from sliding. This will cause a great saving on a railroad, as sliding wears out the wheels, and is a source of constant expense.

The inventor does not intend that there shall be any collisions of his moving battery trains, and one of his inventions is an automatic flag-giving system. By means of this each train will flag itself around curves or at any dangerous point. When a train arrives at a certain distance from the curve an electric current is closed which raises a red flag or lantern on the other side of the curve.

Still another of Mr. Stoker's ideas is an automatic ventilator for railway cars. By a system of electric lights on which he has applied for a patent, the storage battery in the engine will furnish the light for the cars, and the miserable little coal oil lamps will be no more. The engine will also gleam forth into the darkness with an electric headlight, and the inventor has a system of electric lighting for switches.



Allegheny County Light Company's New Station.



Allegheny County Light Company's New Station.

New York's Board of Electrical Control.

New York, Aug. 6.—At the meeting of the board of electrical control last week applications were received from two electric light companies for permission to erect new poles upon which to string additional wires. The American Electric Manufacturing company asked to be allowed to erect 1,302 new poles in the upper west side of the city. The Harlem Lighting company called attention to the fact that they had already made an application for new poles in the same part of the city. In the discussion which followed the mayor advised that the applications be laid over until the gas commission awarded the contracts for public lighting As usual Mr Gibbens opposed the mayor and as usual Mr. Gibbens got the worst of it. The mayor remarked that since he had been in the office he had had to study some law and he wished to put himself on record as believing that the board was created to get the wires underground and not to duplicate and multiply those already overhead. Mr. Gibbens said that he wished to put himself on record as differing from the mayor in every point. The controversy between the two was continued:

"So that you may be put on record," responded the mayor, "I move that permission be given to all the existing electric light companies to erect poles and string wires."

"That is a little too broad," remarked Mr. Gibbens.

"Then I'll withdraw it and let you offer one," obligingly offered the mayor.

Mr. Gibbens read a resolution reciting that it be the policy of the board and "its line of duty" to allow fair and free competition between electrical companies, provided the same can be done without any danger, pending the construction of the underground conduits.

"I move as an amendment," said Mayor Hewitt, "that all men shall do unto others as they would have others do unto them." [Laughter.]

Mr. Gibbens was dumbfounded.

"Do you mean that as an amendment?" he asked, and the question was repeated by President Hess.

"Certainly I do," responded the mayor, "and I think it is entirely germane to the question. The resolution, as offered by Commissioner Gibbens, is simply a string of platitudes, and it is quite right that I should round it off by adding another platitude, and will put in the ten commandments if necessary."

"If the mayor will withdraw his frivolous amendment," said Mr. Gibbens, "I will withdraw my resolution."

"You mean your frivolous resolution," insinuatingly remarked Mr. Hewitt.

"I didn't say my frivolous resolution, sir," replied the young commissioner. "I said your frivolous amendment."

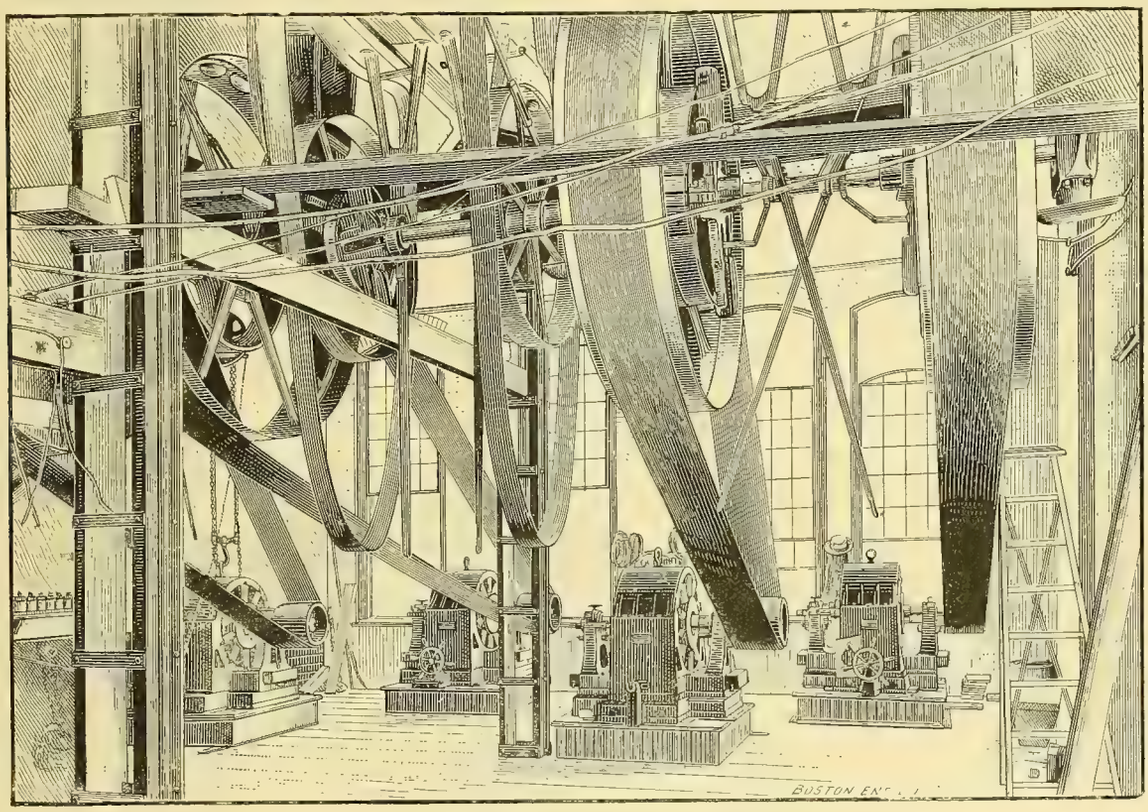
"This is the first time I have ever heard a remark of our Saviour termed frivolous," declared the mayor.

"I said as an amendment," corrected Mr. Gibbens.

"The saying was an amendment to the old moral law," was the answer of the mayor.

It was unanimously decided to delay action on all the applications and to have a tabulated statement made of the needs of all the companies.

Later in the meeting Mr. Gibbens moved that Park Benjamin be asked to appear before the board and give his views about a system of house connections from the conduits. The mayor objected to this as he thought he was too old to go to school. If the other commissioners wanted Mr. Benjamin to give them lessons they could have him, but he would be excused. A competent electrical engineer should be appointed who would look into the matter and listen to suggestions. As usual the mayor's opinion prevailed.



Allegheny County Light Company's New Station.

Electro-Deposition of Iridium.

In a patent recently issued to Wm. L. Dudley, of Covington, Ky., the inventor describes a process of depositing iridium, by means of which a bright, flexible reguline deposit is obtained. The inventor uses either an aqueous solution of the double chloride of iridium and sodium, or of the double chloride of iridium and ammonium, containing about two ounces of metallic iridium to the gallon, and acidified with about one-half an ounce of sulphuric acid to the gallon. The solution of the double chloride of iridium and sodium is prepared as follows: The hydrate of iridium is dissolved in the least possible quantity of hydrochloric acid and evaporated in a water bath to expel the excess of acid. The residue is then dissolved in water and an amount of sodium chloride is added sufficient to combine with all of the chloride of iridium present to form the double salt. The solution is then diluted to the required amount, so as to contain about two ounces of metal to each gallon of liquid. The required amount of sulphuric acid is then added and the solution is ready for the electro-deposition.

The solution of the double chloride of iridium and ammonium is prepared as follows: The hydrate of iridium is dissolved in the least possible quantity of hydrochloric acid and carefully neutralized with ammonium hydrate. It is then acidulated with sulphuric acid until all of the precipitate produced by the ammonium hydrate is dissolved, and finally diluted with water until each gallon of the liquid contains about two ounces of the metal. The solution is then ready for work when acidified, as before mentioned. From both of these solutions Mr. Dudley obtained a thick, bright and reguline deposit of iridium; and he has found that a plate of iridium or phosphide of iridium, as made by the Holland process, if used as an anode, will dissolve in these solutions while the current is passing. As in electro-plating with other metals, it is essential, to obtain good results, that the articles to be plated should be perfectly clean. A brighter and smoother deposit is obtained if the articles are highly polished before they are introduced into the iridium bath. In plating articles which are readily attacked by the solution, it is of course desirable to first coat them with some metal not appreciably affected by such solutions.

In the deposition of iridium from any of its solutions it is necessary to avoid battery power of too great intensity; and in case the intensity be too great, it can be recognized by the deposit becoming dark and powdery, and also by an excessive evolution of gas from the surface of the anode and cathode. In managing the solution, alkalinity should be avoided, although neutral solutions may be employed; but acid solutions are to be preferred. During deposition, where a thick deposit is required, it may be found necessary to remove the articles from the solution from time to time, and to wipe them in case the deposit should have a tendency to become black; but this blackness may be avoided by proper manipulation of the solution and battery power, and also by proper cleansing of the articles. It is also found that when the articles to be plated are kept in gentle motion during deposition, the deposit will take place faster and be brighter and thicker than if they are allowed to remain stationary. Mr. Dudley does not claim, however, that the plating produced by his process will resist the action of acids which will dissolve finely divided iridium.

In seven years a Michigan farmer has had seven horses killed by lightning.

Recent Tests of Incandescent Lamps.

We are in receipt of some interesting and valuable information regarding the new Mace incandescent lamp, or "luminoid," now being introduced by the Vitrite & Luminoid Co., in connection with their insulating material, "vitrite."

Walter T. Goolden, M. A., Fellow of the Chemical and Physical Societies of London, etc., reports that after a photometrical and electrical examination, conducted under his superintendence, of various samples of luminoid lamps sub-

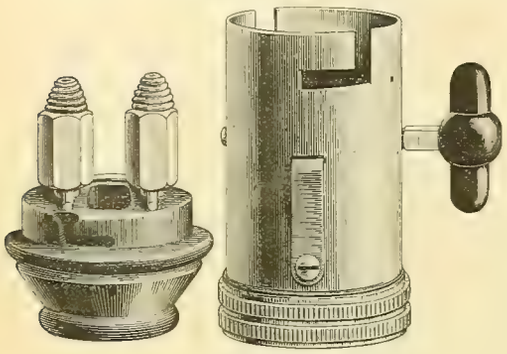


FIG. 3.

mitted to him during the past six months, and after witnessing and examining the process of manufacture, he had formed a favorable opinion of the merits of the lamp on the following points: 1. Constancy of illuminating power throughout its life. 2. Durability under current. 3. Strength and elasticity. 4. Facility and cheapness of manufacture. In regard to the first point, he cites the following instances in support of his opinion that the lamp is superior to any in the market: "November 1st, 1886, two lamps were examined, marked 70 v. 20 c. p. These had been running for over 1,500 hours at 70 volts, the volts being measured by a Cardew voltmeter, for whose correctness I am able to vouch. The test showed that at 70 volts they each took an average current of .96 amperes, and gave 22 candles. Presumably, therefore, they had not lost candle power by their long run, their efficiency at this pressure being 3.1 watts per candle. On the same day a batch of lamps were tested by me previous to running; they were then run for 912 hours and again tested, the results being given in the appended table. The lamps were marked 45 volts 16 c. p., and they were in both cases tested at 16 candle power:

Distinguishing Mark.	Before Running.		After Running.	
	Volts.	Ampères.	Volts.	Ampères.
1	44.0	1.32	44.5	1.36
2	43.0	1.31	43.0	1.30
6	45.2	1.31	45.0	1.25
7	46.0	1.35	45.0	1.34
8	45.5	1.38	45.5	1.30
Average	44.7	1.33	44.4	1.31
Watts per candle 3.7			Watts per candle 3.6	

"Thus the lamps show no falling off in candle power or efficiency after a long run, which would admittedly have reduced the light of the lamps of the best English makers by from 25 to 50 per cent.

"With regard to the durability of these lamps, while it is impossible to speak absolutely, from the absence of specific evidence, I may point out that the above named tests certainly tend in this direction, and that from what I know of the constitution of the filament, I may predict with considerable confidence that it will prove very superior in this respect to a carbon filament pure and simple. The filaments are remarkably strong and elastic, several of the lamps which I have seen having come from America in the ordinary post, without accident or damage to any of the filaments. The filaments of these lamps also present very marked physical differences to those of ordinary carbon filaments, some of them sustaining a full current for some little time in the air—from two to three minutes—before giving out. The process of manufacture, which I have seen and studied, compares not unfavorably with known modern processes of lamp manufacture in point of quickness and expense. I may say that nearly all the luminoid lamps tested by me have shown signs of careless manufacture, the vacuum being usually very imperfect; and the lamps in other ways gave evidence of bad workmanship. It is certainly remarkable that under such conditions the new luminant should present such a marked superiority to lamps made with all the skill attained by English manufacturers."

The following abstract from a paper read by Major-General C. E. Webber, before the Society of Arts last December, is quoted for the purpose of readily comparing the differences observable between the simple carbon filament and the aluminous carbon filament, the latter not being subject to the acknowledged law governing the former:

Mean current and candle power of two long-lived 100 volt. 17 candle power lamps (carbon) of different makers, run at 100 volts and tested every 100 hours.

								Watts.	Watts per Candle.
	Initial current	=	.63a	C. P.	=	18 5		63	3.4
After	100 hours	"	"	.65a	"	"	18.8	65	3.4
"	200 "	"	"	.65a	"	"	20.7	65	3 1
"	300 "	"	"	.65a	"	"	18.5	65	3 5
"	400 "	"	"	.65a	"	"	18.5	65	3.5
"	500 "	"	"	.65a	"	"	18.5	65	3.5
"	600 "	"	"	65a	"	"	18.	65	3 6
"	700 "	"	"	.65a	"	"	17 5	65	3 7
"	800 "	"	"	.64a	"	"	15 5	64	4.1
"	900 "	"	"	.64a	"	"	15.2	64	4.2
"	1,000 "	"	"	.64a	"	"	15.2	64	4 2
"	1,100 "	"	"	.64a	"	"	15.2	64	4 2
"	1,200 "	"	"	.64a	"	"	15.2	64	4.2
"	1,300 "	"	"	.64a	"	"	15.2	64	4 2
"	1,400 "	"	"	.64a	"	"	15 2	64	4 2
"	1,500 "	"	"	.63	"	"	13.7	63	4 6
"	1,600 "	"	"	.63	"	"	12 7	63	5.

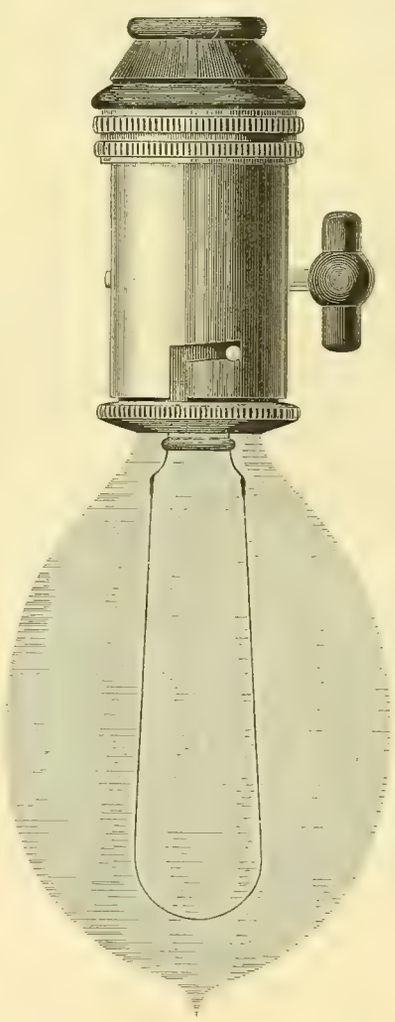


FIG. 1.

"This gives a little history of the changes of the filaments during its life. The tale told may be summarized as follows: That during the first 200 hours the resistance decreases slightly, with consequent increasing brilliancy. These conditions remain nearly stationary for the next 500 hours. After that they alter perceptibly, increasing in resistance and decreasing in brilliancy in a progressive ratio. But it must not be forgotten that the increase in the resistance of the filament is not the sole cause of the loss of light. As the filament ages, its original smooth surface roughens, and is consequently increased in larger proportions than it would naturally be decreased by the loss of bulk. The larger surface requires more current, whereas the increased resistance is gradually reducing the supply.

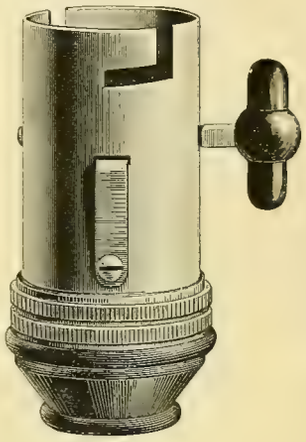


FIG. 2.

"Another cause of the loss of light is due to the blackening of the glass by a carbonaceous deposit, which also increases with age. This latter loss, in 1,000 hours' consumption amounts, in a good lamp, to 15 per cent. This clouding over of the lamp bulb is due to an internal deposit due to the disintegration of the material, either of the wire mount or of the filament.

"Dr. Fleming gave the Physical society in 1883 and in 1885, a description of some curious phenomena incidental to this aspect of the use of glow lamps. It is sufficient to our purpose to mention the cause and the effect.

"As time goes on in the life of a glow lamp a smoky deposit is apparently inevitable; but, quoting Dr. Fleming, 'In normal use, when the lamp is not being pressed beyond the E. M. F., at which it is intended to be used, there is a general evaporation of carbon going on from all parts of the loop.'

"His experiments tended to show that when an excessive temperature is given to the filament by a higher E. M. F., the molecules are projected with violence against the glass, causing by the more rapid disintegration an earlier obscuration of the globe than should arise under normal conditions of consumption. The rate at which the clouding takes place is rapid in the case of some defective filaments. But as a rule makers have conquered this difficulty, and it takes place under conditions which are preventible. The loss of light is very slight, and the appearance of a clouded lamp by daylight is, I think, its most objectionable feature.

"Any user of glow lamps on his own installation will find, when he replaces old ones by new, that the latter will give more light, so that, if he introduces a new lamp to replace one which has been broken at a period when most of the lamps are, say, 900 hours old, he will perceive a difference of about two or three candles if he uses seventeen candle power lamps. If the old lamps are, say, 1,700 hours of age, he may find a difference of seven or eight candles. As the current is not economized in proportion to the loss of light, he should recollect that a point may be reached when, by continuing the use of old lamps, there arises an important waste of power. Hence the public should judge of the efficiency of lamps, outside certain limits, more by their constancy of candle power rather than by their length of life. Thus the best lamp is that which lives the longest with least variation of light."

Comparing these actual records, it is found that after 900 hours actual burning, carbon lamps lost in candle power 18 per cent., carbon lamps lost in efficiency, 23 per cent., and after 1,500 hours, the loss amounted to 26 per cent. in can-

dle power and 47 per cent. in efficiency; while aluminous-carbon lamps lost nothing, but on the contrary gained slightly in both candle power and efficiency, whether measured after 900 hours, or after 1,500 hours' use. This is remarkable, and is due to the composition of the filament, which may be said to be a mineral substance artificially prepared as shown by the following report by one of the best electro-chemists in London, Dr. Albert J. Bernays: "The material employed in the production of the aluminous carbon filament is a mixture, intimately constituted by various simple and cheap chemical processes of pure oxide of aluminium (*alumina*) with a graphitic form of pure carbon, highly elastic, and exceedingly difficult of combustion. The oxide of aluminium is most suitable for the purpose for, at least, four good reasons: 1. It is cheap, and easily obtained pure. It fuses at a high temperature, obtained by ignition through the electric current in absence of air, and thereby protects the filament greatly from possible oxidation. 2. Alumina greatly strengthens the filament and allows of better carriage, joltings, etc., than other filaments. 3. Itself not a good conductor, alumina tends to increase the resistance of the filament. 4. Unlike most metallic oxides, alumina is not reduced to the state of metal by carbon, at least not at the temperature to which the filament has been exposed in the experiments within my knowledge. Such an action would be detrimental, as it would diminish the resistance, generate gas in the lamp and thus injure the vacuum, waste the carbon, and diminish the filament."

The Vitrite & Luminoid Co. make a specialty of luminoids, of which they produce a great variety to suit all systems, both dynamo and battery style, as well as different candle powers. Their standard lamps are from 16 to 150 candle power, and .6 to 10 ampères in almost any candle power. They also manufacture vitrite, which is a vitrious material having the insulating properties of glass or ebonite; it grasps and holds metal parts which may be firmly imbedded in it during the process of manufacture; is non-inflammable; is not affected by heat, cold, gases, or acids, and does not shrink, expand, or warp. This company occupies neutral ground entirely, not having anything to do with dynamos, arc lamps, motors or systems, but confines itself solely to incandescent lamps and fittings.

Fig. 1 of the accompanying illustrations shows the style of the incandescent lamp submitted for the tests prescribed; Fig. 2 the holder separate from the lamp but complete in itself, and Fig. 3 the holder separated into its parts.

Chicago's Electric Light Plant.

August 8th the commissioner of public works of Chicago awarded the contract for the electric light plant to be used for lighting the Chicago river and bridges to the Western Electric company for the gross sum of $29,295.

The recapitulation of bids shows proposals from the following companies:

Excelsior Electric company, two bids, each $34,745.

Fort Wayne Jenney Electric Light company, $29,500.

Brush Electric Light company, three different proposals, $37,060, $36,682.50, $36,347.

Western Electric company, four different proposals, $29,295, $29,649, $30,112, $30,825.

United States Electric Lighting company $34,565.

Cowle & Vandenburg, representing the Sperry system, electric light plant only, $6,500.

Chicago Arc Light & Power company $35,000.

S. S. Badger, representing the American Arc Light company, electric plant only, $7,451.

Ball Electric company, four proposals, $39,440, $38,040, $39,840, $38,640.

The different bids of any one company are due to the different prices of engines included in each proposition. The Payne, Ide, Williams, Russell, Buckeye and Reynolds-Corliss engines were represented in the different proposals. In cables, the Patterson, kerite, okonite and standard were figured upon by different bidders, and the variance in the proposals of different companies is explained in part by the variance in prices at which the different cables were figured.

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number VI.

The Alternate Current Dynamo.—Fig. 14 is a perspective view of a late style of the Siemens-Halske alternate current dynamo. The field magnets are excited by a separate current furnished by a small, constant current dynamo, as shown; this arrangement having been found better adapted to the purpose in this style of construction than self-incitement by the alternating current.

Among the older alternate current machines is that of Lontin, the armature of which consists of coils wound on iron cores radiating from the central axis like the spokes of a carriage wheel, while the field magnets, similarly constructed and of the same number, are attached to the interior surface of an outer rim inclosing the armature; the whole arrangement resembling a carriage wheel with the spokes cut off near the outer rim; the rim with its stubs constituting the field magnets, while the interior constitutes the armature; the bobbins tapering towards the center and ending in short bevels at their outer extremities. This machine is capable of being so arranged that it can produce a number of separate, independent electric circuits, or unite them so as to produce one or more circuits of varying strength By this arrangement twelve independent lamp circuits can be supplied from a machine having an armature with twenty-four bobbins, or all these can be united into one. Brushes are dispensed with, the currents being taken from binding-posts attached to the electro-magnet rim on opposite sides; switches being arranged on one side by which the several circuits can be united or separated as required. This feature of furnishing independent circuits is found also in some constant current machines of the older styles, but improvements in the construction of the lamp circuit has rendered such independent circuits unnecessary.

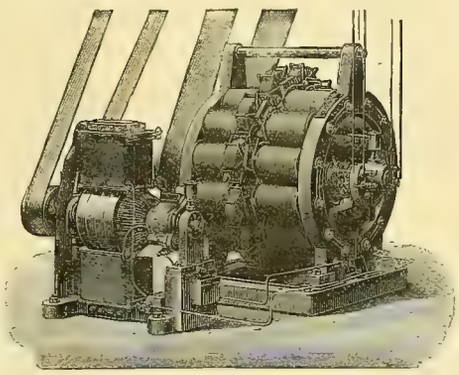


Fig. 14.

Gordon's large alternate current dynamo, shown in Fig. 15, is the most powerful dynamo yet constructed, being capable of feeding 5,000 incandescent lamps of twenty candle power each. The armature is stationary, while the field magnets rotate. The latter consist of sixty-four coils, wound on brass bobbins, placed on cylindric iron cores on opposite sides of the rim of a central rotating disk, thirty-two on each side, the cores extending through the disk, and projecting on either side. The armature coils are attached to two exterior fixed disks, one on each side of the rotating disk, there being sixty-four coils on each stationary disk, 128 in all. The cores of the armature coils, like those of the field magnets, are of iron, but wedged-shaped, tapering toward the center, German silver being used for the flanges to resist the circulation of electric currents. Each disk is eight feet nine inches in diameter; the total weight of the machine is twenty-two tons, and that of the central rotating magnet disk seven tons. The latter has a speed of 140 to 180 revolutions per minute, and a direct attachment to the steam engine, without belting. All the frame work is of iron, the rotating disk of wrought-iron and the fixed disks of cast-iron; and wood is used to insulate the bobbins from the frame. The field magnets are excited by two constant current dynamos, the current which circulates through their coils being received by brush contacts on two insulated metal rings, fixed on the central shaft on opposite sides of the machine; while the induced current, which feeds the lamps, is taken directly from the coils of the fixed armature; their terminals being attached to insulated binding posts on the rims of the armature disks. Thus any irregularity in the lamp circuit which might arise from brush contacts in a machine with such powerful currents is obviated. Since there are twice as many armature coils as field magnet poles, it is evident that as the magnet disk rotates its sixty-four poles can induce electric currents in only sixty-

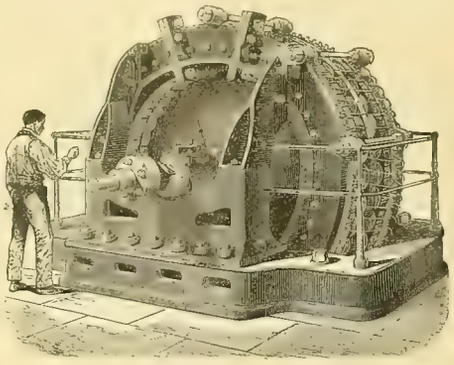


Fig. 15.

four armature coils at a time, leaving each alternate coil of the armature idle; at the next instant the sixty-four idle coils come into action while the others rest; and this alternation of action and rest continues at each successive instant. In the original construction there were only sixty-four armature coils; but it was found that the mutual induction between adjacent coils caused a loss of fifty per cent of the current, while, by having an idle coil between each two active ones, this inductive effect is neutralized. The armature coils are thus divided into two groups, the oddly numbered ones constituting one group, and the evenly numbered another group, each group constituting an independent circuit; and these two circuits can be used separately, or joined in parallel or in series, according to the requirements of the lamps. As the north and south magnet poles alternate, the alternations of current produced at each revolution equal $64 \times 138 = 8,192$. And this product, multiplied by 180, the maximum number of revolutions of the magnet disk per minute, gives $180 \times 8,192 = 1,474,560$ alternations per minute, when running at maximum speed. The advantage gained by the revolution of the field magnets instead of the armature consists in the fact that the rotating disk is capable of a much stronger construction, being made of massive wrought iron, a construction which would not be suitable for the armature for obvious reasons. This disk acts as a flywheel, giving steadiness of motion, and neutralizing irregularities in the movement of the engine, which would otherwise produce fluctuations in the light. Direct attachment to the engine also prevents unsteadiness which often results from slipping of the belt.

For large electric lighting installations there are obvious advantages in the use of such powerful dynamos as the one just described. The steadiness of the light depends largely on the generator; a fluctuating current must produce a fluctuating light; even in the best regulated systems a certain amount of irregularity is unavoidable, but if this irregularity is divided among 5,000 lamps its effect is far less perceptible than if divided among a smaller number.

Another advantage is found in the economy of labor, large machines requiring less attendance in proportion to the results produced than small ones.

At Holyoke, Mass., the local electric light company has contracted to furnish street lights for a period of three years. The company agrees to maintain sixty-eight or more arc lights, to burn until midnight, at thirty-seven and a half cents each per night, fifty cents to be paid for each light that burns the entire night. Last year the rates were forty-five and sixty cents respectively.

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A BRANCH of the Bank of England, it is authoritatively stated, is to be established in Pueblo and on the heels of this announcement follows the rumor that an American bank is to be started in the City of Mexico. It is evident that the importance of Mexican trade is being realized by Americans.

THE latest in regard to the cable war is that representatives of the various companies have held conferences and are now haggling over the pool rate. It is said that Western Union desired a 50-cent rate; the Direct people were willing to go to 60 cents; the French and Anglo-American companies would agree to any figure that was high enough, while Mr. Mackay insisted upon a rate not more than 40 cents, although he preferred 25 cents.

A BERLIN physician states that he has discovered a new disease already firmly established among telegraph operators, but fortunately confined to them. The continual tapping of the telegraph key causes the operator's finger nails to drop off. Several cases of this new disease are already noted among the older Berlin operators.

This is probably one form of pen paralysis, a disease common to operators as well as penmen, and resulting from the continued strain on certain muscles of the hand and arm, required by the arduous work of large city offices; the nature of the work affording very little variety of muscular action.

IN an article in the last issue of the WESTERN ELECTRICIAN a description was given of a mine in New Zealand where an electric motor was used to drive the crushing machinery, and it was stated that motor manufacturers of this country had been considering the mining regions of the west as a market for their products. Since then word has reached us that a large electric plant has been contracted for a prominent California mine. It is only a question of time before other mines, now lying undeveloped on account of the great expense of power, will be in operation by means of the electric motor, to which the current will be supplied from generators situated at a distance, but where there is an available water power or central steam plant.

At present all motor manufacturers are crowded with orders. The demand is brisk, the consumption steady and the market is at home or near by—in other words, manufacturers have not been compelled to hunt for a market in the far west. But that market is a good one, and, as said before, the introduction of motors in the mining regions will unquestionably prove of mutual advantage to both miners and motor manufacturers.

A LIGHTNING-rod man is always regarded as the legitimate subject of a joke. Perhaps the reason is that the joke is—ninety-nine times out of a hundred—on the other fellow. General Stiles, one of the keenest of Chicago lawyers, and connected with the prosecution of the "boodlers" is noted more for what he does not say than what he says. A lightning rod man had been called by the defense to prove the previous good character of one of the "boodlers." A verbatim report of the cross-examination of the witness by General Stiles is as follows: "Are you a lightning-rod man?" Witness—"Yes, sir." Gen. Stiles—"That's all." Whereat a broad smile went over the faces of all those present in the court room.

YOUNG SANGER, the district telegraph boy sent by Manager Frohman to England on the 27th ult., arrived in London on the 5th inst. and began delivering the souvenirs to the various addresses that had been given him, but was arrested the same night on the charge of violating the British postal laws. His detention was brief, however, as he was promptly released on an explanation of his errand. The point in sending the lad to London from New York, it will be remembered, was to prove that an average, bright district telegraph lad could make the trip and return in as quick time as any traveler. The experiment will demonstrate either the affirmative or negative of two propositions: That an American lad is equal to all circumstances and that the district telegraph messenger is as rapid in his service as anyone else could be under similar conditions. We believe the affirmative of both propositions.

IN the course of an interesting article on electric street railways in Europe, an English contemporary deplores in lengthened terms the red tape methods pursued in Great Britain in connection with the introduction of new enterprises, and to that restricting influence is attributed the slow progress made in introducing electric railways into the British Isles. The article says that in the United States electric tramways are successfully at work in many of the larger cities, and that preparations are going on in America to widely extend this method of traction. This looks as if we must go aboard to hear the news. We have for some time been searching large and small cities in America for an electric street railway in successful operation, but we have not yet been able to find one. There are numerous rumors to be heard of electric tramways running successfully, but when they are chased up they prove a veritable will o' the wisp. This season has been noted for a remarkable extension of street railways in the United States, and a large mileage of cable has been put down for operating street railways, and there is no difficulty in locating the cities where the "grip" is making headway, but we can not definitely locate any of the much talked of electric street railways.—*National Car and Locomotive Builder.*

Well, we will locate a few cities that occur to us at the moment, without making any pretensions at a complete list: Appleton, Wis., Detroit, Mich., Windsor, Ont., Scranton, Pa., Port Huron, Mich., Binghamton, N. Y., Lima, O., Los Angeles, Cal., San Diego, Cal., four roads, and Montgomery, Ala. These are roads that are in successful operation. As was shown a week ago, the average cost of running a 10 horse power car in the last mentioned city, per day of eighteen hours, including coal consumption, wages of engineer and helper, fireman and helper, oil and sundries, is but $1.10

Omaha is to have an electric street railway; one is being built in New York city, and at Asbury Park, N. J. one is about completed. As stated, the list makes no pretensions at being complete, but it is long enough to show that the English contemporary referred to was correctly informed as to American electric street railways and that our American contemporary really did have to go abroad for the news, though not inclined to accept it.

IN nearly all of the reports of personal injury by lightning-strokes victims who recover say they saw balls of fire. The fire-ball seems to figure conspicuously in all stories of prostration by lightning, and it would be interesting to study this special phase of the phenomenon for the purpose of ascertaining whether the fiery ball has any existence except as the result of the bright flash upon the optic nerves. Almost invariably the persons who are close enough to a flash of lightning to see this ball have declared that it moved slowly, dancing and bounding through the room or across the field, and in cases where men and women have been prostrated and subsequently recovered they have asserted that the ball bounded slowly toward them and struck them full in the chest. I recently talked with a man who was in a factory which was struck by lightning, and he told me that two balls of fire approached him from the end of the room, slowly bounding along the floor and leaping almost to the ceiling. When they reached him, he said, they both struck him on the breast at the same instant, and he fell insensible. The factory chimney was struck on this occasion and partly demolished. He recovered in fifteen minutes and carefully examined his clothes to see if they were burned.

I firmly believe that the ball of fire is merely an optical illusion, and that it is seen only by persons who are not in the direct line of the electric current.—*New York Sun.*

We have already referred to the theory of ball lightning, and expressed the opinion that it is a subsequent effect of electric action rather than an electric appearance *per se.* Doubtless in the cases mentioned above it is an optical illusion, while in other cases it is a result of combustion produced by the lightning. In regard to this phenomenon, as seen on the tips of the masts and yards of ships during storms at sea, it is no doubt a true electric appearance, known as the brush discharge, resulting from difference of potential between the ocean and atmosphere, causing an electric discharge either to or from those projecting points on the ship. The ship being the only object elevated above a vast expanse of surface is much more liable to furnish occasion for such phenomena than a building or other elevation on land, surrounded by trees, buildings, and other elevated objects. But even on land this brush discharge has been observed on the tips of lightning conductors during thunder storms.

Death by Electricity.

A number of interesting experiments have just been made with such electrical machines as are employed in industries, with the view of determining under what conditions they may become dangerous. These have been conducted by M. D'Arsonval, who has already established the fact that what is truly dangerous where these machines are used is the extra current that occurs at the moment the current is broken, and in order to annul this extra current he proposes to interpose a series of volta-metres containing acidulated water along the conducting wire. The new arrangement now employed is at once more simple and efficient, says the London *Times.* It consists of a V-shaped tube made of an insulating substance, which, after being filled with mercury, is interposed in the main current. In order to close the latter it is only necessary to turn a tap, which is arranged similarly to the tap on the gas pipe. In this way the machine is unprimed without its being able to give an extra current spark. Another arrangement is also made use of, a glass tube being filled with mercury and dipped into a reservoir containing the same substance. The tube is provided with a ground stopper, this not only permitting the suppression of the extra current, but also interposing any sort of resistance to the current. Although these details appear rather technical, they relate to a most important matter. The use of electrical machines is increasing, and it is of practical use to know that currents are not dangerous until a power of 500 volts is reached. It is also of interest to know that the mechanism of death varies with the nature of the electricity used. Thus, with the extra current, or with alternating currents, there is no anatomical lesion, and the patient can usually be brought back to life through the practice of artificial respiration, as employed in cases of drowning. The discharge of static electricity from batteries, on the contrary, causes a disorganization of the tissues that renders fruitless all attempts to restore life.

National Electric Light Convention.

Special Dispatch to the WESTERN ELECTRICIAN.

BOSTON, MASS., Aug. 9.—The sixth meeting of the National Electric Light association is by far the largest ever held, two hundred and twenty-three names being already registered. Moreover, the exhibits are on a much more extended scale than usual, and altogether the meeting promises to be a very enthusiastic one. Below will be found the names of those present and the proceedings of the first day.

President, J. F. Morrison, of Baltimore, Md.

Boston Electric Light Co., Boston, Mass.—Mayor Hugh O'Brien, F. A. Gilbert, P. Fahy.

Thomson-Houston Electric Co., Boston, Mass.—Chas. A. Coffin, S. A. Barton, W. B. Hosmer, E. W. Rice, H W. Burget, P. H. Alexander, H. N. Curtis, G. W. Davenport.

Sawyer-Man Electric Co., New York—Gen. C. H. Barney, P. H. Alexander.

Baxter Electric Mnfg. & Motor Co.—Benson M. Green, Wm. M. Baxter, jr., David Evans.

U. S. Electric Co., Baltimore, Md.—P. O. Keilhaltz.

Southwark Foundry & Machine Co., Philadelphia—James A. Pentz.

Jarvis Engineering Co., Boston, Mass.—A. F. Upton, Boston; J. N. Pratt, New York; H. A. Glasier, Chicago.

Cleveland Electric Motor Co.—L. Wright, F. E. Pettengil, Geo. W. Mansfield, J. J. Miller, Wm. Henderson, E. B. Gethune, Geo. W. Short, C. A. Brayton.

U. S. Illuminating Co., New York—E. T. Lynch, jr.

Callender Insulating & Fire Proofing Co., New York—A. W. Butterworth.

Electrical Review, New York—Geo. Worthington, Chas. W. Price, A. V. Garratt, F. M. iIGley.

Geneva Non-Magnetic Watch Co., New York—A. C. Smith, Addison Conkling.

Faraday Carbon Co., Pittsburgh, Pa.—Geo. F. Porter.

Edgerton Electric Motor Co., Philadelphia—H. H. Edgerton, W. E. Sharp, W. B. Buchanan.

Brush Electric Light & Power Co., Savannah, Ga.—T. P. Keck.

Millville Electric Light Co., Millville, N. J.—Stephen Holbrook.

Bridgeport Electric Light Co.—Henry D. Stanley.

Bridgeport Brass Co.—Fred A. Mason.

New Haven Electric Light Co.—Jas. English.

Riverside & Oswego Mills, Providence, R. I.—R. T. Robinson, W. A. Huse.

Munson & Co., Chicago—J. H. Shay, J. H. Thomas.

Brush Electric Light Co., Philadelphia—A. J DeCamp.

Standard Carbon Co., Cleveland, O.—J. B. Crouse, D. A. Dangler, W. H. Boulton.

The *Electrical World*, New York—C. E. Stump, T. C. Martin, Jos Wetzler, W. I. Barker.

Western Electric Co., New York and Chicago—F. W. Harrington.

The Okonite Co., New York—Geo. T. Marson.

St. Joseph Electric Light & Power Co., St. Joseph, Mo.—W. C. Stewart.

Empire City Electric Light Co., New York—W. I. Wark.

Louisiana Electric Light & Power Co., New Orleans—Samuel J. Hart.

Allegheny County Light Co., Pittsburgh—S. A. Duncan, T. Carpenter Smith, R. W. Ryan, New York.

Fort Wayne "Jenney" Electric Light Co., Fort Wayne, Ind.—P. A. Randall.

Thomson-Houston Electric Light Co., Kansas City.

Baker & Co., Newark, N. J.—C. O. Baker, jr.

Worcester Electric Light Co., Worcester, Mass.—H. H. Fairbanks.

Sun Electric Co., Woburn, Mass.—Frank Redlow, M. M. M. Slattery, J. E. Talbott.

Vitrite & Luminoid Co., N. Y.—Romain Mace.

Kansas City Electric Light Co., Kansas City, Mo.—E. R. Weeks.

The Electrical Construction & Supply Co., New York.—F. E. Kinsman.

Locke Patent Damper Regulator Co., Springfield, Mass.—C. C. Webber.

E. P. Gleason Mfg. Co., New York.—E. F. Gennert, Wm. F. Cullen, Arthur Sewart, Baltimore, Md.

Electrician and Electrical Engineer, New York.—Geo. M. Phelps, jr.

John J. Williamson, Boston, Mass.

Armington & Sims Engine Co., Providence, R. I.—Gardiner C. Sims.

C. & C. Electric Motor Co., New York.—H. S. Lurkin.

S mplex Electrical Co., Boston, Mass.—A. F. Mason, A. C. Pond, E H. Batchelder.

Mather Electric Co., Chicago.—J. H. Reid.

A. L. Russell, Boston.

Bernstein Electric Light & Mfg. Co., Boston.—Henry B. Cam, Oscar S. Bussman.

Thomson-Houston Electric Co., Chicago.—G. W. Atkinson, F. H. Goden.

Charlestown Gas Co., Charlestown Mass.—Geo. B. Neal.

Citizens' Electric Illuminant Co., Brooklyn, N. Y.—E F. Peck.

Blodget Bros. & Co., Boston—A. D. Blodget, T. H. Brady, New Britain, Conn.

Eastern Electric Cable Co., Boston.—Henry A. Clark, H. H. Eustis.

Hugh J. Toland, Superintendent of Lamps, Boston.

Boston Fire Underwriters' Union, D. Killicut.

Chicago Arc Light & Power Co., Chicago.—A. H. Brown.

Newton Electric Light and Power Co., Newton, Mass.—H. G. Pratt, H. H. Cutler.

Otto A. Moses, New York.

Thos. D. Lockwood, Boston.

W. S. Hill, Boston.

R. W. Prentiss, Professor Columbia University.

Samuel Elder, Boston, "American" system.

Day Kerite Wire and Cables, Ralph W. Pope, Chas. L. Ireson, Boston.—Leather Link belting.

Brush Electric Light Co., Cleveland, O.—Wm. Swift.

New York Insulated Wire Co., New York.—J. W. Godfrey.

American Tool & Machine Co., Boston.—H. Barker.

Waite, Williams & Co., Boston.—Geo. W. Waite, E. H. Williams.

WESTERN ELECTRICIAN, Chicago.—W. A. Kreidler, T. B. Pemberton.

Boston Electric Protective Association, Geo. W. Adams.

New Bedford Gas Light Co., New Bedford, Mass.—Gilbert Allen, Robt. B. Tabor.

New Bedford Electric Light Co., New Bedford, Mass.—Wm. Lewis.

S. B. Hillman, Philadelphia.

National Carbon Co., Cleveland O.—N. C. Hayes, C. D. Smith, W. H. Lawrence.

The Electric Accumulator Co., New York.—F. Latshaw, Prof. A. Reckenzaun.

New England Wiring Co., Boston.—W. J. Paine, H. B. Prindel.

Sprague Electric Railway & Motor Co., F. J. Sawyer, Edward Blake of Boston.

Scoville Mnfg. Co., Waterbury, Conn.—Leonard Waldo.

W. A. Hall, Boston.

John T. Noye Mnfg. Co., Buffalo, N. Y.—A A. Noye.

Hartford Dynamo Co., Hartford, Conn.—Chas. H. Weed.

Syracuse Electric Light Co., Syracuse, N. Y.—A. P. Seymour.

Brush Electric Light Co., Norfolk—W. W. Chamberlain.

Boigmann & Co., Boston—W. C. Livermore.

Julien Electric Co., New York—C. O. Mailloux.

Davidson Steam Pump Co., Boston and New York—N. E. Park.

Brush Electric Light Co., Detroit, Mich.—W. W. Leggett.

Rogers Auxilliary Fire Alarm, Boston.—Otis N. Howland, S. P. Wardwell, G. W. Daniel.

Malden Electric Light Co., Malden, Mass.—A. E. Bliss.

New England Telepone Co., Boston.—A. H. Chapman.

M. M. Packard, Baltimore, Md.

M. M. Rand, Lynn, Mass.

J. F. Patten, Duluth, Minn.

Thos. W. Clarke, Boston.

S. O. Richardson, jr., Boston.

J. W. Darley, Baltimore, Md.

American Electrical Works, Providence, R. I.—C. A. Ackerman.

Somerville Electric Light Co., Somerville, Mass.—H. F. Watts.

L. B. Wright, Boston.

Municipal Electric Light Co., Brooklyn, N. Y.—Charles Cooper.

W. H. Harding, Baltimore, Md.

J. H. Churchill, Boston.

J. R. Edwards, Washington, D. C.

J. B. Hatch, jr., Boston.

Parker-Russell Mining & Manufacturing Co., St. Louis—G. W. Parker, D. R. Russell.

R. H. Whittier, Providence, R. I.

E. M. Carhart, Providence, R. I.

W. H. Fleeming, Liverpool, Eng.

Frank Fuller, Boston, Mass.

M. C. Kerr, Pittsburg, Pa.

Frederick Boyce, Washington, D. C.

Enos Electric Railway Co., Boston.—C. J. Messer, S. P. Messer.

C. J. H. Woodbury, Boston.

B. W. Kellogg, Boston.

John B. Martin, Boston.

J. P. Stanley, Boston.

California Electric Light Co., San Francisco.—Geo. H. Roe.

Thos. Leavitt, Boston.

John Flint, Brooklyn, N. Y.

B. E. Priest, Boston.

N. D. Finley, Boston.

E. P. Sparrow, Boston.

John N. Candee, Poughkeepsie, N. Y.

A. T. C. Daniel, Boston.

Thos. C. Sims, Boston.

Herbert C. Wist, Boston.

Bradley Electric Power Co., New York.—C. L. Bradley.

Fiberite Manufacturing Co.—Thos. H. Rown.

Geo. H. Hartwell, Boston.

Boston Rubber Shoe Co., Boston—G. L. Richard.

North Attleboro Steam Electric Co.—H. M. Daggett, jr., L. W. Dillon.

Ball Electric Light Co., Boston.—H. M. French.

The meeting was called to order at 10:30 this morning at the Parker House, with President Morrison in the chair. He opened the meeting with the appended address:

"GENTLEMEN OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION: I have again to congratulate you upon the success of your organization, which the large attendance to-day from all over the country evidences. Inventive ability and irrepressible energy of the most pronounced character still farther encourages us in the belief that if the electrical business does not achieve a phenomenal success it shall not be for want of intellectual activity, energy and integrity. Great progress has been made in the last six months in electric lighting generally, but especially in the development of the incandescent system. The induction system, which permits of low tension lamps at a great distance from the station, is a branch of lighting that has greatly increased since the last convention and is now successfully conducted in many places. This system, more than any other formerly in use, is designed to find its place in the illumination of private houses. Its flexibility is very great. Its farther development is encouraging. Lighting by storage batteries has also received a great impetus within the last three months, and while there are still some difficulties to overcome in certain branches of illumination, it is fast superseding the dangerous oil lamp on railway trains.

"Dynamos have been perfected so as to give greater efficiency per pound of metal used, and our electricians are constantly working to reduce the cost of the machines, thereby insuring a large market for the same. The perfection of the arc lamp has increased, and the demand for the same in the last six months exceeds the output of the previous eighteen months. Mill owners and others are beginning to realize the enormous advantages of the electrical illuminator, not only in the more healthful condition of the operatives, but also in the greatly decreased fire risks. The underwriters throughout the country recommend the introduction of incandescent lights to their patrons in all factories where inflammatory fabrics are made.

"Abroad, the introduction of electrical install-

ations has been slow and unsatisfactory, but of late our brethren across the ocean have taken up the subject with vigor, and to-day are becoming formidable rivals in the enterprising spirit of this country in the adoption of electrical energy for all uses.

"The patent office question, perplexing and unsatisfactory as we are well aware it is, is now receiving attention through the agitation of the subject by this association, and we intend to keep this matter before the world until legislation shall be compelled to furnish what is needful.

"As suggestive of the multiplicity of uses to which electricity may be put, Lieutenant Murdock submits a paper setting forth and explaining the electrical requirements for the new government cruisers. Although this especial electrical application would necessarily be limited, it would, no doubt, be useful, and still farther evidences a desire for the application of electrical devices in every branch of industry.

"The perplexing wire gauge matter will again be placed before you and if the work of the past six months of the committee on this subject corresponds with the exhaustive and excellent report made at the last convention, we may expect something definite enough this time to decide the attitude of this association in relation thereto.

"I regret to have to announce the absence of the report of the committee on insulation of wire and proper installation and construction of plants. This committee requested the association to provide the necessary means to enable them to carry out their investigation, but as the association was in no condition to render them the pecuniary aid they required, they determined not to pursue their work any further. I believe this to be a loss to the association, as from the statements they have made of what they intend to do, if they only had the means, I can easily forsee the loss of a great deal of valuable information to ourselves and to the world at large."

President Morrison then introduced the mayor of Boston, who welcomed the delegates to the city in a few well chosen words. After hearing the reports of the secretary and treasurer, the report of the legal committee was made by Mr. Stewart, who included patent legislation in his report. Mr. Stewart recommended the establishment of a court in the patent office that would embody in itself the jurisdiction now divided among half a dozen different officers, the increase of the force in the patent office and the establishment of a laboratory for the conduct of experiments. Mr. Stewart went on to say that his committee was preparing a digest of the literature of electric lighting which they felt sure would be useful to the association.

It was moved and carried that the Stewart committee be continued and authorized to take steps necessary to get the bill as presented passed by congress.

The report of committee on revision of the constitution was next called for.

Mr. DeCamp said the committee had found so many amendments to the constitution that they had concluded to submit an entirely new constitution and it was laid before the convention. It was then taken up clause by clause and discussed, the discussion resulting in its being referred back to the committee for later report during this convention. Mr. Duncan was added to the committee on by-laws.

The report of committee on wire gauge was next presented by Mr. Garratt, who called attention to the fact that his committee had been continued from the Philadelphia meeting, where they reported in favor of the metric system and that after a good deal of hard work they had, to a considerable degree, got their results in final shape and prepared a mathematical table which he hoped to get electrotyped at once and so become the property of the association.

Dr. Moses stated that although a member of the committee, he had taken no heart in the work, having been abroad or sick during the time it had had the subject of wire gauge under consideration. He warmly commended the committee for the comprehensive and laborious work they had accomplished. As to the metric system he said it was so well known and so generally used that there was no necessity for defending it as a standard.

Mr. Mason asked for information as to what would be the effect of the adoption of the committee's report by the association, and what had been the effect of the adoption of the committee's previous report.

The president, after consulting the minutes of the previous convention informed Mr. Mason that at that convention Mr. Powers, of Troy, moved that the matter be left in the hands of the committee for a further term, and that the committee be increased to five, with instructions to report further at the next semi-annual convention; that in the meantime the report of the committee be accepted and placed on file; that such suggestion as the committee made in regard to printing copies be carried out in order to enable members to familiarize themselves with the new gauge in case it should be adopted at the succeeding convention, and that Mr. Powers' motion was carried.

Mr. Lynch suggested that Mr. Garratt add to his report a column showing the full current carrying capacity of the wires at different temperatures.

Mr. Garratt stated that he would do so.

Mr. Stewart spoke in commendation of the work of the committee and moved that their report be adopted.

After further discussion by Mr. Phelps and Mr. Garratt, the president suggested that the subject be made a special order for a fixed hour on Thursday, so as to enable members to study the details.

On motion of Mr. Mason the subject was laid on the table and made a special order for the opening of Thursday's session.

The president called for the partial report of the committee on "Insulation and Construction of Plants."

Mr. Robertson stated that he had been unable to indorse the partial report prepared by the other members of the committee and that he begged to resign, finding himself in so small a minority. The resignation was accepted.

The report was read by the secretary and discussed by Mr. Eustis, Mr. Mason and others, and on motion of Mr. Leggett, it was laid on the table. Mr. Leggett stated as his reason for making this motion that the committee having admitted that it was but a partial report, it would hardly be fair to them to spread it on the minutes of the association as a report from that committee.

The convention then took a recess until half past two. On re-assembling Mr. Slattery read the report of the committee on "Electrical Distribution by means of the Alternating Currents."

Mr. Duncan said in regard to the difficulties suggested by Mr. Slattery that those were being gradually solved and were stated in the paper. One of the difficulties was with the induction-box itself; but practical experience of four months in the use of these boxes had been such as to show that they are entirely efficient and satisfactory and can be relied on to be placed in any position and to do their work effectually. He did not know that they got any more heat from the alternating current dynamo than from the arc light dynamo; he did not think they got much less; he knew that they did not get much more. He knew of machines that had run successfully for three months without anything having been done to them, some of them averaging in a week's run 24 hours per day except Sunday.

Mr. Smith, of the Alleghany County Light company, having received shocks from both an alternating and a direct current machine, expressed a decided preference for the former. He thought the Thomson-Houston machine gave the most tremendous blow he had ever felt, but the alternating machines seems to throw it off instantly; "you do not have time to take hold." He said that he was a little enthusiastic on the subject of the alternating currents. In Pittsburg they were using the direct system multiple arc. They had been struggling with 0000 wire, pulling their poles out of line, and the direct current machine burning armatures etc. Taking the two systems into account, the ease of distribution and the ease of handling, he thought that the alternating system was bound to come, if for nothing else than for the enormous reduction it made in the cost of running a station.

Dr. Moses said that the same machine in the station at South Pittsburgh, with a lone, solitary man that Mr. Weeks saw there, was there still, but they had doubled up their capacity and that one man was running it.

Mr. Kingsman stated that he had succeeded perfectly in burning an arc light with a fifty volt converter from the alternating system of the Westinghouse company and that he got twelve hours time from twenty-four inches of carbon and a perfectly steady light. The lamp he used was the Simplex lamp, two thousand candle power and fifty-five volts.

After some further remarks by Messrs. Kimball, Decamp, Smith and Slattery the report was accepted on motion of Mr. Garratt.

E. R. Weeks, of Kansas City, then read a paper on "Electrical Education."

In reply to a question put by Mr. Smith, of Jamestown, Mr. Weeks stated that there were many books sufficiently popular in their style to be of great use to employes. If Mr. Smith would get a list of electrical works from any of the New York electrical papers he would be able to choose from thirty to forty books sufficiently simple and elementary to form a nucleus of a library for employes.

Mr. Garratt commended, as adapted to the needs of workingmen, a book by Sylvanus Thompson called Elementary Lessons in Magnetism and Electricity.

The following resolutions were, on motion of Mr. Mason, adopted:

"*Resolved*—That the work that was assigned to the committee on 'Insulation and Installation' is of such importance that this convention can not allow the subject to escape their earnest attention; that the subject is of the utmost importance to the electric lighting business and one in which there must be abundant material and experience which can be obtained without expense to this association.

"*Resolved*—That a committee of five on 'Insulation and Installation' be appointed to report at the next meeting, and that Dr. Otto Moses be the chairman of the committee."

Dr. Moses demurred to being made chairman of the committee, while expressing his willingness to serve as a member.

The president said he would appoint the committee, and endeavored to induce Dr. Moses to serve as chairman.

The president placed Mr. Leggett on the Committee on "Revision of the By-laws."

Mr. Mailloux moved that a committee on nominations and to select a place of meeting be appointed by the chair.

The motion was carried, and the president appointed as such committee Messrs. Mailloux, Leggett, Robertson, Moses and DeCamp.

The convention then adjourned until ten o'clock on Wednesday morning.

Through the courtesy of the Boston Electric club and the Thomson-Houston Electric company the delegates are to enjoy a boat-ride tomorrow, down the harbor, a visit to the Thomson-Houston factory at Lynn, and a banquet in the evening at the Point of Pines.

[The foregoing report, received by wire, covers the first day's proceedings of the convention. The next issue of the paper will contain the full proceedings of the second and third days and the papers read the first day.—Ed. W. E.]

A Floral Clock.

A clock recently patented in France is in imitation of a tambourine, on the parchment head of which is painted a circle of flowers corresponding to the hour figures of ordinary dials. On examination two bees, one large and the other small, are seen crawling among the flowers. The small bee runs rapidly from one flower to another, completing the circle in an hour, while the large one takes twelve hours to complete the circuit. The parchment surface is unbroken and the bees simply laid upon it, but two magnets connected with the clock-work inside the tambourine move just under the membrane, and the insects, which are of iron, follow them.

Mertillow R. Clapp, of the Clapp & Jones Manufacturing company, of Hudson, N. Y., died July 28th of Bright's disease, in the sixtieth year of his age.

CORRESPONDENCE.

News from New York.

NEW YORK, Aug. 2.—The eastern states have been recently visited by a series of storms which, although of a different nature from the western tornadoes, have been sufficiently prolific in water and electricity to give them unusual prominence in the meteorological records. New York city has for years been comparatively free from damage by lightning, but on Tuesday night about 9 o'clock a sharp flash was immediately followed by the extinguishing of the arc lamps on lower Broadway, and electric wires of every description received their quota of the surplus electricity which was so suddenly turned loose in that vicinity. The occasional failure of electric lights does not appear to create any prejudice against their use for street lighting, yet it seems as if every precaution should be taken to insure perfect service for the general welfare of the business.

The gas commission, composed of the mayor, comptroller and commissioner of public works, met on the 29th of July to consider the agreements with the electric lighting companies for lighting the city. This has heretofore been harmoniously divided between the Brush and United States local companies at 70 cents per night for each lamp. The appearance in the field of various companies who proposed to do the same work for less money has, however, led to a reduction in the price to 25 cents per night. At this session of the commission the mayor growled because the agreements were not ready before, and complained that the city was still paying the old rates. This was denied, however, and the commission proceeded to business and decided to advertise for lighting new districts. The mayor has been a determined advocate of general electric lighting of the streets, but not at the old prices. He is a firm believer in the importance of thorough street illumination as a relief to the police department in guarding life and property at night. Arrangements were considered for lighting Bryant and Mount Morris parks, the mayor stating that they should either be well lighted at night or else closed. He had heard that Bryant park had been the scene of some disorder at night. The lighting of both these parks will be included in the advertisement for bids.

Mrs. Hicks-Lord, whose residence on Washington place was robbed some time ago, has had a private arc lamp placed in the rear of the building, the front being already adequately illuminated by two city lamps in the park. Electricity is continually lowering the value of burglary as a profession, and its practice in this city will soon be among the lost arts. In addition to the surveillance of the police department, the thoroughly systematized organizations of patrolmen, in connection with electric burglar alarms and watch boxes operated by private corporations, has forced the burglar into less remunerative, but also less dangerous fields. South Jersey was recently "worked" by a couple of brothers who spent several weeks along the railroads, utilizing for transportation purposes a railway velocipede which they stole from the car-house at Ocean City. They were thoroughly familiar with the train schedule, and seem to have experienced no difficulty in breaking into various stations on the lines of the West Jersey, Camden, and Atlantic and New Jersey Southern lines, making no very large hauls, however, and consequently being obliged to continue steadily at work, until finally their boldness in operating up to daylight led to their capture, and they are now lamenting their rashness behind the bars of Camden jail.

The semi-weekly sessions of the board of electrical control continue to attract numerous visitors, and the press of the city is well represented. Mayor Hewitt does not hesitate to publicly exhibit his antagonism to his colleagues in the board, and he apparently delights in sarcastic observations upon their attempt to master the problem of burying the wires. He asserts that he shall oppose the construction of any more conduits until a satisfactory system of distribution is adopted. He will not indorse any system of distribution that involves the use of poles or overhead wires. As the board was established, primarily, for the purpose of placing the wires underground, he objects to granting privileges for poles and wires in the annexed district, for instance, where one company desires to place 1,500 poles in order, among other things, to provide for street lighting, should it secure a contract for that work. At the meeting on Friday, July 29th, Mr. Gibbens was appointed a committee of one to tabulate the applications for pole privileges, in order that no permits should be granted for duplicate routes. The caustic character of these tilts between the members of the board must be heard to be appreciated. Mr. Gibbens thought that new companies should be granted the privilege of putting up poles, so that they might compete with the old companies. If the company securing the privilege should not get the contract for city lighting, the successful bidder could then use the other company's poles to string wires on. The mayor replied that in his experience he had found that when he owned a thing he had what is called "the bulge on it." This view was concurred in by Messrs. Hess and Moss, but Mr. Gibbens still argued in favor of competition. Upon the offering of a resolution inviting Park Benjamin to come before the board and explain why it was proper that the conduits should be constructed even if no plan of distribution had been adopted, the mayor said it would be a waste of time. "I am too old," he declared, "to go to school. You want Park Benjamin to come and give me lessons. If I want lessons I will send for that gentleman. You may have Mr. Benjamin here, but I will ask to be excused to attend to more important business. You should appoint a competent electrical engineer who would look into the matter and listen to suggestions from Mr. Benjamin or anybody else." As the mayor has placed himself in an antagonistic minority, he has been obliged to use the authority of chief magistrate of the city in order to prevent what he fears may be improper appointments.

Several down-town merchants have united in addressing a protest to the sinking fund commission against the leasing of any property on Burling slip to the North and East River railroad company for a power station. Such a plan is contemplated for the generation of electricity for the operation of this line. All other apparent obstacles have been cleared away, and the motors may be started up before winter sets in. It is gratifying to know that companies engaged in manufacturing electric plants for railway purposes are overwhelmed with orders. The existence of these systems will enable inventors and manufacturers to continue the work of improvement until all details are fully arranged.

P.

Eastern Electrical Gossip.

NEW YORK, Aug. 6.—Telegraphing to and from moving trains seems to have passed the experimental state and, judging from the reports given of the satisfactory service of the system on the Lehigh Valley road, is a positive success. The Consolidated Railway Telegraph company have had operators on three trains each way daily on that road between Perth Junction and Easton for some months and, aside from the revenue received from passengers who patronize the system, it has been found of great advantage to the superintendents and dispatchers on account of the facility with which they can communicate with the trains they wish to control. The system is particularly adapted to single track roads on this account, and in cases of break-downs or accidents at a distance from telegraph offices, much valuable time can be saved by its use.

Various electricians have, for some time, been proposing to propel yachts by means of storage batteries. We are soon to have a practical trial of the scheme, as there is now building at Newburg a 37 ft. boat that will be driven by a current from a storage battery.

John J. Carty, for several years superintendent in charge of the operating room of the Boston exchange, has severed his connection with the New England company, and on the first of August assumed charge of the Western Electric company's cable work in the east.

The New York & New Jersey Telephone company is preparing to move into its new and commodious general offices on Smith street in Brooklyn. It is expected that the new multiple board being built for this company will be ready for use by the first of January when the operating room will be moved into the same building. The company is now erecting a building in Williamsburgh to be used for an exchange there.

Schemes for building underground roads in this city are very numerous just now, and nearly all are proposing to use electricity as a motive power. The latest is the revival of the plan to tunnel the East River. Last week there was filed in the office of the secretary of state at Albany the certificate of incorporation of the New York & Long Island Railroad company. The length of the proposed tunnel will be about five miles, and it will extend from the Long Island railroad at Hunter's point to the New York Central at Ninth avenue and Thirtieth street, with a loop to the Grand Central Depot. The plan calls for a double track, and the trains will be operated by electricity and also be lighted by it.

H. H. Kingsbury, who is connected with the telegraph, telephone and electric light business at Sydney, Australia, and who represents the Western Electric company there, is in the city. He is on his way from London to Sydney, and expected to leave San Francisco on the 26th inst., but thinks he will remain in this country another month that he may have more time to look about. He says that Australian methods of doing business are more like American ways than English ways.

The corporation counsel has advised Mayor Hewitt that all the work of the board of electrical control in authorizing the opening of streets to lay conduits is illegal until a plan has been perfected and approved for a complete system of conduits for the entire city.

The cross connecting board used with the Metropolitan company's new multiple and mentioned in last week's letter, was designed by Mr. Eckert and Mr. Seeley of that company, and attracts a great deal of favorable attention from visiting electricians.

S.

From the Pacific Slope.

SAN FRANCISCO, August 1. — The twenty-second annual report of the fire alarm and police telegraph of San Francisco shows that last year there were 299 first alarms, six second alarms and one third alarm. This is the highest number of alarms ever sounded from the office. The expenditure for the service was $16,399.12 and the appropriation was $17,100.

There is now being operated in this city a private system of fire-alarm gongs. Connection is made by a contact maker in large gongs at the several companies and radiating branch circuits, upon which small gongs are placed in the residences of the "call" members of the fire department. The alarm, when struck at the companies' headquarters, is transmitted over these lines, which are operated by independent batteries, placed in the various houses of the department. These lines in no wise interfere with the working of the main fire alarm circuits. Superintendent Curran recommends that the existing plant be substituted by newly constructed circuits to be maintained by the city government, and incorporated into the department, thereby guaranteeing to the fire department the reliability which is afforded them over the regular wires.

The supervisors have requested the California Electric Light works at San Francisco to erect sixteen more masts in the suburbs, each mast to carry four-thousand candle power lamps.

A movement has been inaugurated by some capitalists in San Francisco and Los Angeles to build an independent telegraph line from San Francisco to the southern portion of this state. The company will be incorporated with a capital of $200,000. The purpose is to build to Los Angeles first and thence to San Diego, Phœnix and other points in Arizona and southern California. Overtures have been made to the Southern Pacific company for the privilege of erecting the line on its right of way and other preliminary steps have been taken.

The electric light plant at Oliva Heights is being put in position for use and will be in operation for illuminating the towns of Santa Ana, Orange, Tustin and the Santa Ana valley by the

ast of the week. It is also proposed to utilize the electricity for power to run an electric railroad from Santa Ana, Orange, St. James, Oliva Heights, Modena and Tustin, making a circuit of fifteen miles. This plant is to be run by water power.

Joseph McDonough, a capitalist, is accredited with the intention of erecting a hotel on a grand scale at the north-east corner of Fifteenth street and New Broadway. The plans are now being considered and the building contemplated will be of fire proof construction. Its dimensions will be 300 x 275 ft. It will be provided with elevators, fire escapes, electric bells, annunciators, return and fire alarm calls, and is to be lighted by incandescent lights. It will also embrace a theater and several stores. A part is to be devoted to the new bank of which Mr. McDonough is a prominent stockholder.

Taylor Bros., are to put an arc light plant in their large paper mills at Taylorville, Cal.

The Pacific Coast Electrical Construction company have filed the same articles of incorporation in Alameda county as filed in San Francisco. This company started up their lights at Oakland, Cal., on the 25th ult, to the satisfaction of a majority of the citizens of that city.

The Haas gas well in Stockton, Cal., claims a flow of over 100,000 cubic feet of gas per day, besides eight other flows which are now cast off from the well, but which are accessible by breaking the pipe at each flow by giant powder and electricity. It was intended to get a franchise from the city council to lay pipes for lighting the city, but trouble was found by reason of the old gas company's franchise. The gas well company now threatens to run electric lights if the old gas company opposes. The new company claims to have power to run 1,600 sixteen-candle lights.

The Plomeares Hotel Co. at Los Angeles, Cal., has filed articles of incorporation. The capital stock is $60,000. The directors are F. T. Smith, O. F. Griffin, C. C. Olmsted, J. E. Packard and James E. Taylor.

The Electric Improvement Co. have contracted to build an electric street railway at San Jose, Cal. The system to be used is not known.

The Pacific Electric Co. started their new station at Oakland, Aug. 1st, with 110 private lights. The plant consists of three new boilers 55 inches diameter, 16 feet long, one 180 h.p. Buckeye engine, six 30-light dynamos, and several smaller dynamos. The company intend to start next month in the motor business. Their building is a large two-story brick structure at the corner of Second avenue and Western street. The upper floor is used for manufacturing and the lower floor for office, dynamo, engine, boiler and store rooms.

The steamer Mexico that was wrecked at Victory, B. C., last April has been completely rewired and new electric apparatus put in.

The Sunset Telephone Co. have built a new exchange and established new lines at Potterville, Woodville and Plano, with the main office at Visalia, Cal.

Nelson Bennett, a well-known railroad contractor of Tacoma, W. T., has secured the contract and franchise to build an electric railroad through that city. The overhead wire system is to be used. Work has been begun on laying the track. Mr. Bennett also expects to build a road in Seattle and Olympia, W. T.

A company has been formed to introduce the electric light in Albany, Ore.

Walter Blair of Oakland has purchased a a lot at Oakland and will build a station for an electric street railway which he proposes to try on his new road now being laid on Broadway at the rate of about 100 feet per day, and which will probably be completed in a few days. Murray & Bro. have sold him a forty horse power engine. Mr. Blair will use the overhead system of transmission.

C. R. Lloyd has secured the contract to light the Hotel Rubidoux at Riverside, Cal., by incandescent lights. The Indianapolis Jenney system will be used. Mr. Lloyd has also closed a contract for 400 horse power of water power with the Water Co. to be used by the Electric Power & Light Co. who bind themselves to have the works running in thirty days.

R. A. Simon will leave on the 5th on an extended trip through California and Nevada for the purpose of studying the problem of the electric transmission of power for mining, milling and railway purpose from the available water powers of those states.

San Rafel has an electric light plant which was started last week.

Davis & Co's flour mill is to have an incandescent plant. They have been using a 15-light Brush arc light for three years and have contracted with the California Electric Light Co. to exchange for a Brush incandescent plant.

The San Jose Brush Electric Light Co., have contracted with the city council to light that city for $12,500 for the year.

The idea of an electric railway from San Jose to Saratoga has been abandoned for the present.

Geo. R. Roe, secretary and manager of the California Electric Light Co., left on the 30th ult. for Boston, Mass., to attend the national convention. The gas inspector gave a sigh of relief.

The California Electric Light Co., at San Francisco are adding a large Corliss engine, 24"x48" to their station. This makes the second engine of this size added within two years.

The West Coast Electric Construction Co. have filed articles of incorporation. Capital stock $10,000, in shares of $100 each. The directors consist of four lawyers and a bell hanger.

S.

Detroit's Budget.

DETROIT, Mich., August 6.—The argument on the application of the Brush Electric Light company for an injunction against the common council to restrain any authorization on the part of that body to cause disturbance with the poles or wires of said company, was not heard on Thursday, the day fixed, but was put over until next Tuesday. The city authorities asked for more time in order to secure data, showing that the placing of electric light wires undergound, is feasible. In the meantime, Mr. Paige, vice-president of the Brush Co., offers a substitute for the underground system. His plan is practically the same as the one heretofore advocated by Mr. Durant, of St. Louis, namely, to erect iron shafts at the corner of alleys; to be from 125 to 150 feet in height, and cross-armed the same as telegraph poles; lights to be looped in from the nearest shaft. The wires thus strung, would be out of the way of firemen and would clear the highest buildings. An underground system could not do more. The proposition has been submitted to the mayor, but it is not likely to be recommended.

The three years' contract with the Brush Co. for lighting the city has been vetoed by the mayor who, in his message to the council, stated that he could see very little, if any, advantage to the city in the apparent saving of $5,000 a year which would result in accepting the three years' contract in preference to the one-year contract. It appeared to him to be good policy that the city should be left free to take advantage of such developments in the process of electric lighting as the long term of three years might reasonably be expected to bring forth. Fuel was the most important item entering into a calculation of the cost of producing light, and he deemed it unwise and injudicious to accept a contract based upon the present cost of production, just when an era of cheapened fuel was being entered upon. Another reason why the contract should not be entered into was that the Brush Co. was hostile to the ordinance requiring wires to be placed underground. The question of sustaining the veto will come up next week. Later developments would seem to indicate that the Brush Co. would not now sign the contract even if awarded them over the veto. If compelled to put the wires underground it would cost $200,000. This would necessitate an increase of capital and also working expenses, and, of course, the cost of the light would be greater.

The Ypsilanti common council awarded the contract to light the city, to the Jenney Co. of Indianapolis. The mayor's veto was not sustained by a vote of thirteen to one.

Plans are nearly completed to organize an Edison company at East Saginaw. J. R. Markle and J. P. Tillotson, of Detroit, are the prime movers, and are figuring to have the local gas company take hold and organize the company with a capital of $250,000.

The American Bell Telephone Co. has filed suits against Ray Beckwith *et al.*, Kalamazoo and W. A. Soule, Minden City. The defendants are using the Cushman instrument. C.

Indianapolis Items.

INDIANAPOLIS, August 8. — The Jenney Electric Co. of this city are doing a good business. Their latest contracts are for furnishing a 60-light arc plant for Ypsilanti, Mich., and one of same size for San Bernardino, Cal. They have also closed a contract with the Union railway company for the necessary apparatus for lighting their new railway station. The plant will furnish 60 arc lights for train sheds and 1,000 incandescent lamps for the main building.

The Denison house has just been overhauled and refitted. Among its improvements is a Jenney plant for lighting the house throughout.

The New Albany Electric Heat & Power company, of New Albany, Ind., has been incorporated with a capital stock of $10,000. The directors are Jacob Goodbud, John S. Briggs, Edward B. Lapping, L. S. Bradley, Edward C. Hongan, Marion Steele and Isaac P. Leyden.

The people of Elkhart, Ind., who wouldn't have the telephone except under the strict letter of the law, have followed the example of other places and are now using it on the toll system. The exchange began operations this week. M.

THE ELECTRIC LIGHT.

At a recent meeting of the city council of New Orleans the lighting committee was authorized to advertize for bids for lighting the public buildings of the city for five years with incandescent and arc lights and also with gas.

The city council of Shelbyville, Ill., voted to light the streets of the city by electricity, the system to be furnished by the Shelbyville Water company. The mayor refused to sign the ordinance, but the councilmen declare they will have the electric light.

Julian F. Denison, of New Haven, Conn., has invented a device by which burnt-out carbons in arc lamps are replaced as fast as need be. It is said that by the use of his apparatus an arc light will burn ninety hours or more without any attention.

THE ELECTRIC MOTOR.

All leading motor manufacturers are receiving orders from abroad.

Street car horses dying at the rate of forty a day in New York during the hot weather and more than a thousand since June 1st. If the electric motor, with this record, were only on a par with horses in the cost of investment and maintenance, humanity would dictate its adoption, but when electric cars can be run for less money than with horses for power, then humanity is reinforced by economical considerations, and under these circumstances there is but one conclusion: The horses must go.

THE TELEPHONE.

At a recent meeting of the village authoritities of Evanston, Mr. Fay of the Chicago Telephone company entered a protest against permitting electric light companies to string their wires on telephone poles, on the ground of danger. His protest was referred to the proper committee.

THE TELEGRAPH.

The old time and military telegraphers will renew associations in annual convention at Philadelphia on the 17th and 18th of this month.

Articles of incorporation have been filed by the Superior Telegraph & Telephone company of West Superior, Douglass County, Wis.

NEW ENTERPRISES.

L. P. Brown, of Kansas City, Mo., is about to erect a residence to cost $15,000. It will be fitted with electric bells.

J. W. Swain, of the same city, will build a residence to cost $25,000. It will be supplied with all modern improvements.

D. Pulman, of the same place, has laid the foundations for a residence to cost $35,000. The details of the superstructure have not yet been completed.

A new school building to cost $25,000, is to be erected in Madison, Wis. W. O. Williams is the architect.

The city of Salem, Oregon, proposes to put in the electric light. Proposals will be received by T. C. Boone.

The Twin City Gas Co., of La Salle, Ill., are establishing an electric light plant, and propose to lay out about $4,000 on the steam plant.

C. H. Law, of Taylorsville, Ill., is in want of an electric light apparatus.

A new court house to cost $15,000, is to be built at Cimarron, Kan.

W. Babcock, of Kansas City, Mo., will build a $12,000 residence. He will fit it up with electric bells.

The First National bank of Findlay, O., is to be remodelled at an expense of about $25,000.

The Concordia society of Watertown, Wis., will build a $12,000 opera house.

At Columbus, Lowndes Co., Miss., a new jail is to be built. It will cost about $16,000.

T. J. Stackhouse, of Findlay, O., is about to build an addition to his hotel. The estimated cost is $20,000.

Leman & Schmitt, 31 Benedict block, Cleveland, O., are the architects for a new hospital to be built in that city.

Henry Leiser, of Findlay, O., will build a $16,000 residence.

At the same place, U. M. Northrup will build a $11,000 residence.

A business block to cost $10,000 is to be erected in Findlay, O., by Eli Phillips.

At Galveston, Texas, a cotton seed oil mill is to be built by Sampson Heidenheimer, corner of Strand and Twenty-second streets.

At Aurora, Ill., James Howland will build a residence to cost $10,000. It will be fitted with electric bells.

At Findlay, O., Mr. De Oesterlin is about to build a business block to cost $20,000.

At the same place the Ohio Lantern works will lay out $75,000 on a factory.

Preparations are being made by a number of capitalists for the erection of a mammoth summer hotel in Hyde Park, at the foot of Fifty-sixth street. About $500,000 will be invested in the enterprise.

Electrical Patents.

Issued August 2nd, 1887.

367,359. Galvanic Battery. Horatio J Brewer, New York, N. Y.

367,402. Electric Pyrotechnics. John H. Irwin, Morton, Pa. Incandescent lamps, arranged in a circle, spiral or other form, are brought into circuit one after the other to give the appearance of moving fire.

367,422. Electrical Ore-Detector. Lemuel Mellett, Milford, Mass.

367,435. Lightning Arrester for Protecting Oil Tanks. David O'Brien, Philadelphia, Pa. A balloon held by guy ropes above the oil tank is provided with lightning rod points which are connected with a flexible conductor leading to the ground.

367,451. Galvanic Battery. James Serson, Boston, Mass.

367,469 System of Electric Distribution. Elihu Thomson, Lynn, Mass. A constant current electro-motor is used to drive a generator feeding a local circuit; an electro-magnet included in said local circuit regulates the power or speed of the motor as required.

367,470. Regulator for Dynamo-Electric Machines and Motors. Elihu Thomson, Lynn, Mass. The first claim is as follows: "The combination, with a dynamo-electric machine having its field-coils in derived circuit to the work, of a field varying device and means for simultaneously and automatically moving the commutator brushes backward when the field magnetism is diminished, and *vice versa*."

367,471. Coupling Compound Dynamo-Electric Machines. Elihu Thomson, Lynn, Mass.

367,475. Roof for Suspended Electric Conductors. Chas. J. Van Depoele, Chicago, Ill. A snow shed supported upon the cross wires protects the overhead conductors and traveling contact of an electric railway system.

367,523. Burglar Alarm. Benjamin F. Hough, Sandusky, Ohio.

367,541. Electric Ore Indicator. Lemuel Mellett and Jerome Prince, Milford, Mass.

367,548. Electric Conductor. Thomas S. Reed, Bridgeport, Conn. The naked wire is painted with non-siccative paint and then covered with fibrous material which takes up the paint.

367,568. Electric Arc-Lamp. Merle J. Wightman and Hermann Lemp, Hartford, Conn. The invention relates to lamps in which the carbons are held apart when the lamp is not burning and consists in certain constructive details of apparatus for bringing the carbons together to form the arc.

367,598. Electric Railway Signal. Edward M. Chase, Boston, Mass.

367,627. Electro-Magnetic Car Brake. Jacob Herrington, Sharon, Pa.

367,630. Electric Distribution by Secondary Batteries. William Hochhausen, New York, N. Y. Polarized electro-magnetic switches, controlled from a central station, serve to connect and disconnect secondary batteries in circuit at will. A switch, operated by the changes in specific gravity of the battery liquid, is designed to disconnect the battery from circuit when it has received a certain change.

367,650. Electrical Type-Writer. James F. McLaughlin, Philadelphia, Pa.

367,651. Electric Motor. Alexander W. Meston, St. Louis, Mo. The commutator springs or brushes are moved automatically to maintain a uniform speed under any load within the capacity of the motor.

367,662. Programme Clocks. Andrew J. Reams, Augusta, Kans.

367,663. Electric Programme Clocks. Andrew J. Reams, Augusta, Kans.

367,670. Electric Light Switch Boards. Charles E. Scribner, Chicago, Ill. The invention is designed to prevent accidents. When a plug is inserted in a spring jack, all metallic portions of the spring jack are covered by the rubber plug handle.

367,685. Electro-Magnetic Railway Brake. Charles J. Van Depoele, Chicago, Ill.

367,705. Galvanic Battery. Paul Raoul De Fancheux d' Hunry, London, England.

367,720. Printing Telegraph Receiver. Henry Mahnken, Brooklyn, N. Y. The two type wheels rotated independently by separate power connections, are placed outside the frame carrying the power trains.

367,730. Cable Racks for Switch Boards John A. Seely, New York, N. Y. The racks at the rear of the boards are provided with perpendicular slots. These slots are divided off by pins to form separate divisions or holes for the cables. The system is in use at the 39th street New York telephone exchange.

367,734. Terminal for Electric Cables. Robert H. Widdicombe, Chicago, Ill.

367,754. Telephone Exchange Apparatus. William M. Goodridge, Highland Park, Ill. The terminal of each line consists of a flexible cord and plug, the plug being normally inserted in a special spring jack, closes the line to ground, at the same time shunting the cord. On withdrawing the plug to connect with the spring jack of another line, the ground is taken off, and connection at the same time made with the busy-test wire.

367,768. Conduit for Electric Wires and Cables. George D. Sutton, New York, N. Y.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	385	400
Central Union	45	46
Michigan	76	77
Great Southern	30	33
Colorado	20	22
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27

Miscellaneous Notes.

A new type of storage cell is being introduced in Vienna. The lead grid contains large and small holes. Only the large holes are filled with active material, while the small holes are left open so as to allow for expansion without buckling or other deformation. The efficiency claimed by the maker is 91 per cent. of the charge and 78 per cent. of the energy. Each cell weighs 78 pounds complete, the weight of the electrodes being 33 pounds.

The benefits of a police patrol wagon in Covington, Ky., are being thoroughly appreciated. The service is pronounced of great assistance to the police department.

The Belgium war department has ordered an electric search light for naval purposes.

A 15,000 barrel tank of oil belonging to the Eclipse Oil company at Franklin, Pa., was struck by lightning the night of August 5th. The consequent loss was estimated at $20,000.

Business Mention.

The Van Depoele Electric Mnfg. Co, of Chicago, has just closed a contract with Dr. S. D. Mercer, president of the Omaha Motor Railway company, for an equipment which, for the present, will consist of twenty 12 h. p. motors and two 150 h. p. generators.

Captain Robbins, of the Jarvis Engineering company of San Francisco, is putting two Jarvis furnaces in the Alameda electric light station.

Among the contracts recently taken by the Western Electric Co., Chicago, is one for lighting the Chicago exposition this fall. About 100 lights will be required. The same company has also secured a contract for a 25-light plant for the Grand Pacific hotel.

Foree Bain, of 95 Indiana street, Chicago, has been selling quite a number of small motors for running fans. They have been placed on Edison local circuits.

Extensive improvements are being made in the plant of the Bloomington Electric Light company at Bloomington, Ia. A 13"x15" Armington & Sims engine is being put in, making the complement number four—two New York Safety Steam Power Co. engines, one Ball, and the new engine noted. A 250-arc light dynamo and a 1,000-incandescent light dynamo, and new wires and poles are being installed.

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AUTOMATIC ENGINES
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Complete Power Plants Furnished and Erected.
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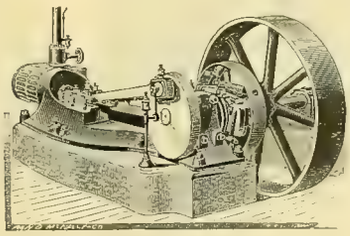

The National Carbon Co.
CLEVELAND, OHIO,
MANUFACTURERS OF
ELECTRIC LIGHT CARBONS
AND
BATTERY MATERIAL.

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Medical Batteries, Skeleton, Iron and Box Bells, Burglar Alarms, Hotel and House Annunciators, Fire Alarm Boxes, Pins and Brackets, Insulated, Magnet, Telephone and Electric Light Wire.

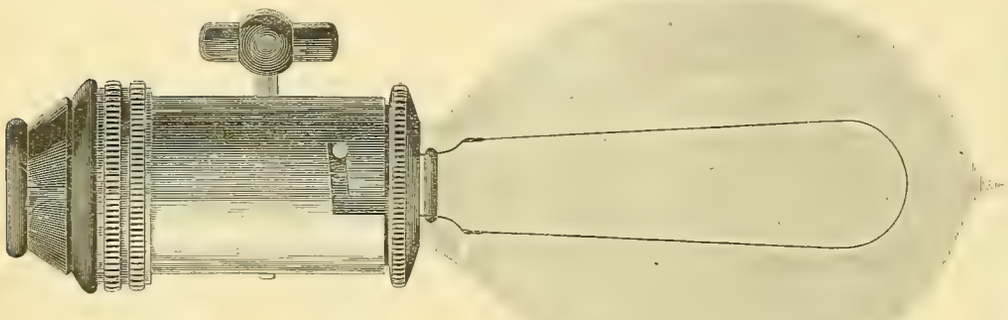
BUILDERS OF

Fisher's Electric Motors,

AND ALL APPLIANCES FOR CITY AND SUBURBAN

ELECTRIC RAILWAYS.

General Offices and Works, DETROIT, MICHIGAN.



ACTUAL SIZE OF LAMP AND HOLDER (Size No. 1,) FOR LAMPS 65 to 100 V. 16 C. P.

Aluminous Incandescent.

We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

CORRESPONDENCE REQUESTED.
CATALOGUES ON APPLICATION.

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SPRAGUE ELECTRIC RAILWAY & MOTOR CO.

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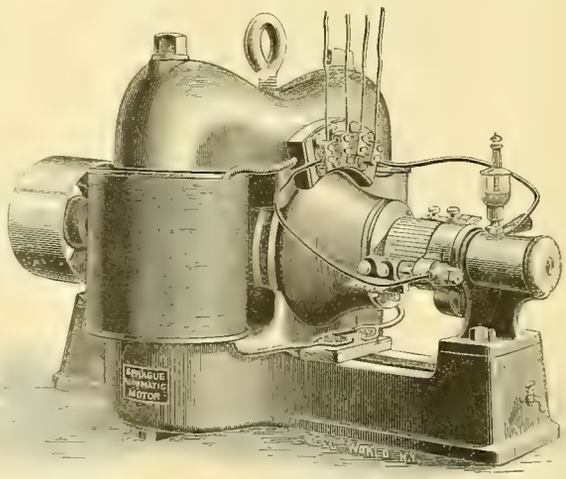
BOSTON, 55 Oliver Street.
NEW ORLEANS, 20 Carondelet Street.
DETROIT, 133 Jefferson Avenue.
CHICAGO, 185 Dearborn Street.
ST. LOUIS, 304 Locust Street.
PHILADELPHIA, 119 South 4th Street.
CLEVELAND, O., 117 Public Square.

The Sprague Motors have been formally adopted for use on the Edison Circuits, and they are being introduced on these and also on Westinghouse, Brush-Swan, Thomson-Houston and United States Circuits, in New York, Chicago, Boston, Des Moines, Elgin, Oskaloosa, Pittsburgh, Chester, Williamsport, Lancaster, Shamokin, York, Detroit, Topeka, Cincinnati, Springfield, New Brunswick, Fall River, New Bedford, Milford, Taunton, Lawrence, Woonsocket, Fort Meyer, Waterbury, Annapolis, St. Louis, Abilene, Pawtucket, Syracuse, Canada, and the Argentine Republic, and have been shipped to Berlin and Milan.

This company has ample means to undertake any desirable contract for the tramsmission of power for any purpose, under suitable guarantees. The company is now possessed of the best facilities for manufacture of any motor company in the world. Arrangements have been made with the Edison Machine Works, to manufacture and carry in stock large numbers of standard machines, and a special factory—the only experimental factory devoted exclusively to that work in existence—has recently been started in New York, and is equipped with the finest tools that are made.

At present there are being operated in Boston seventy-five motors, varying from 1-2 to 25 horse-power.

This is the only company in the United States devoting its entire energies to the different questions involved in the transmission of power, and it is putting into practical use more motors of and over one-half horse-power than all other companies combined.



SPRAGUE AUTOMATIC MOTOR.—15 Horse-Power. 220 Volts. Efficiency, 91 per cent.

The Sprague Company are now also contracting for STREET RAILWAY WORK on an extended scale. They have just been awarded the largest street railway contract for electrical work ever given: the equipment of 12 miles of railway, with 40 street cars, requiring 80 motors of 7½ H. P. each. They have also contracted with the C., B. & Q. R. R. for transfer work at Aurora, Ill., selling the company both the motors and dynamos. One thousand motors are now being constructed at the factories for industrial and railway uses, aggregating nearly 4,000 horse-power.

Correspondence invited, and estimates furnished for complete Central Stations or Special Transmissions up to 1,000 horse-power, and for Street Railway Work.

A NEW AND COMPREHENSIVE ILLUSTRATED CATALOGUE, WHICH GIVES A VARIETY OF FACTS HITHERTO UNKNOWN, HAS BEEN ISSUED AND WILL BE SENT ON APPLICATION.

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Repair Work done and Special Manufacturing attended to. Skilled Workmen in all Departments.

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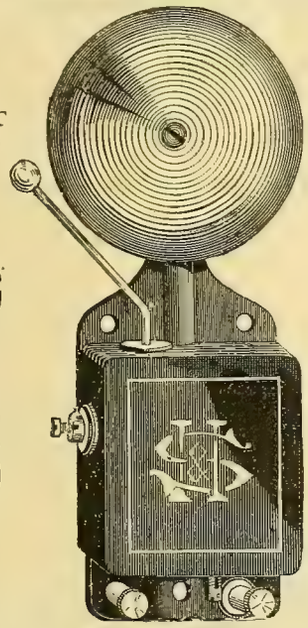

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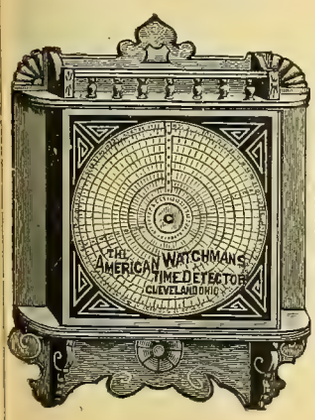

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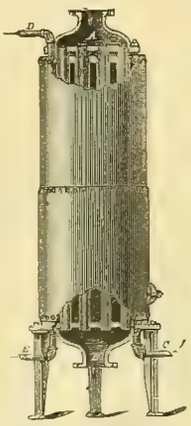

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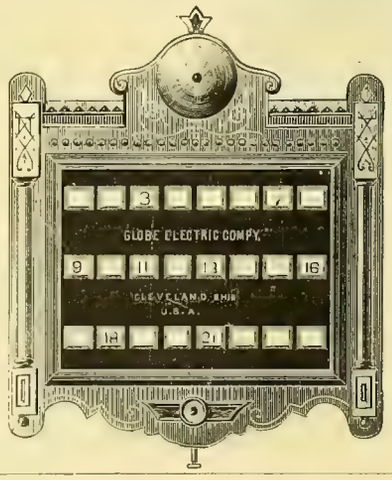

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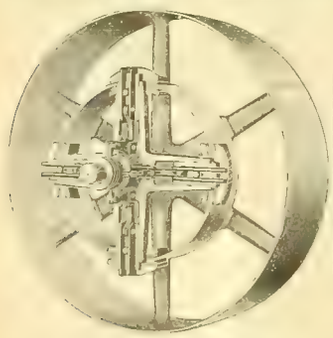

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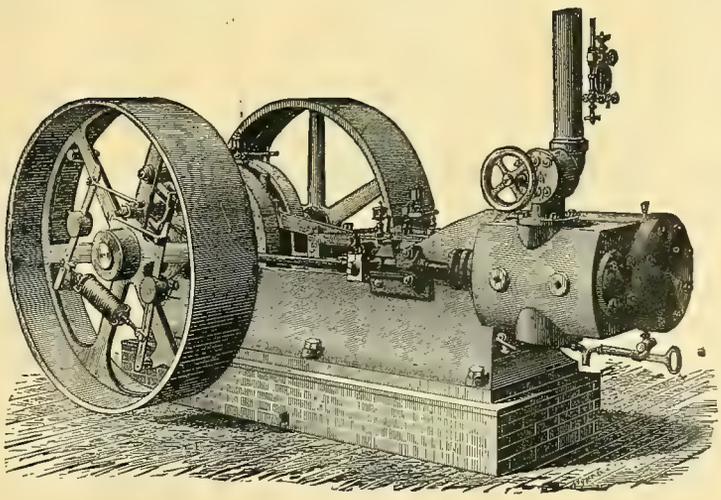

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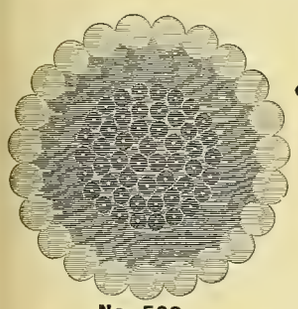

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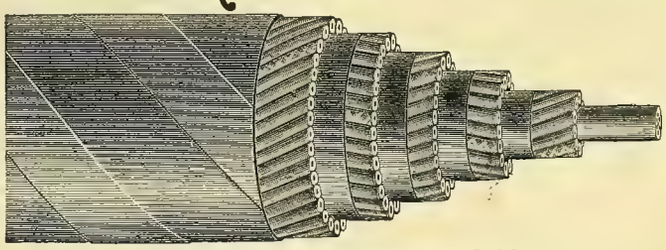

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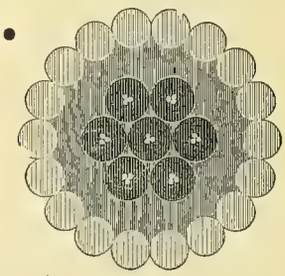

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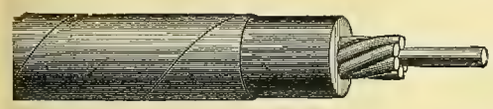

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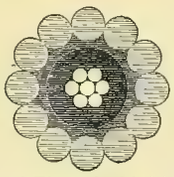

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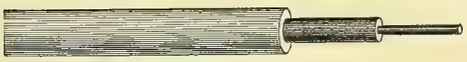

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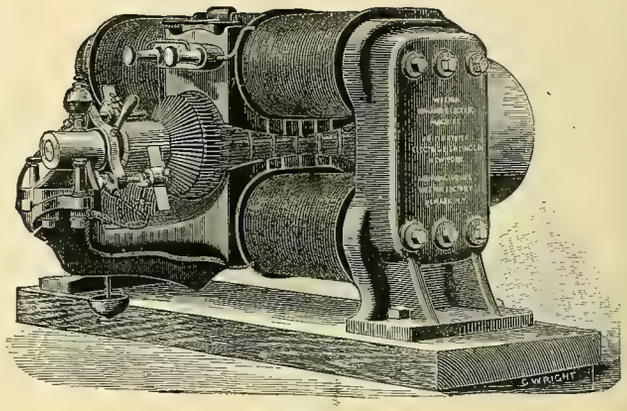

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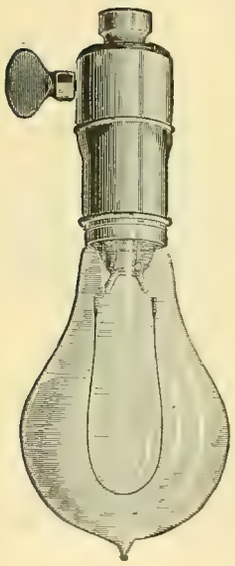

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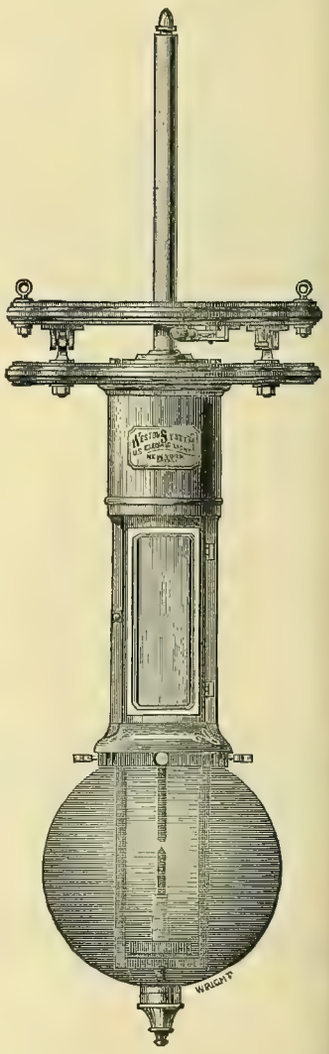

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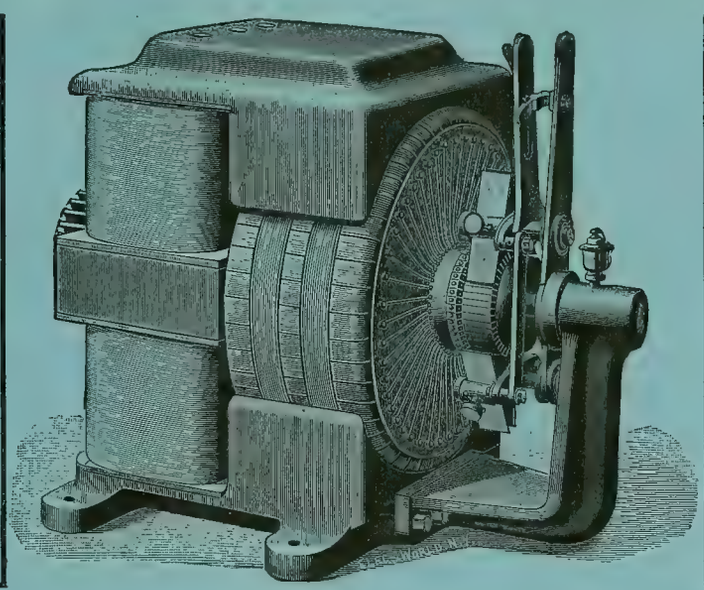

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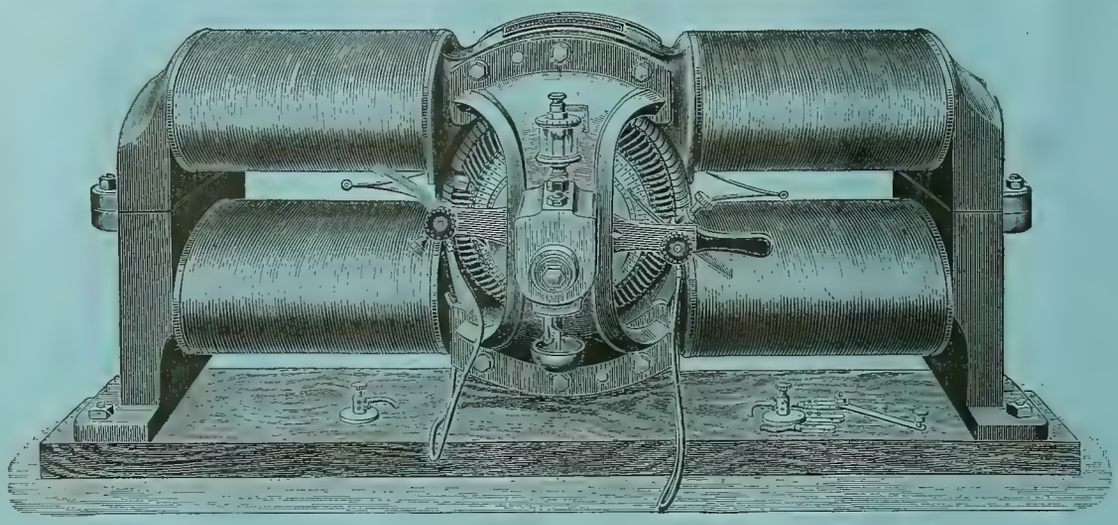

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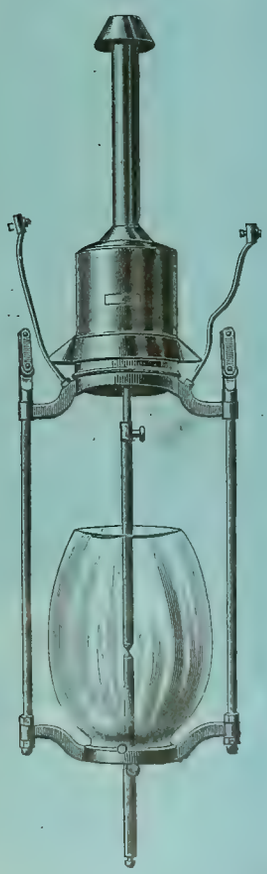

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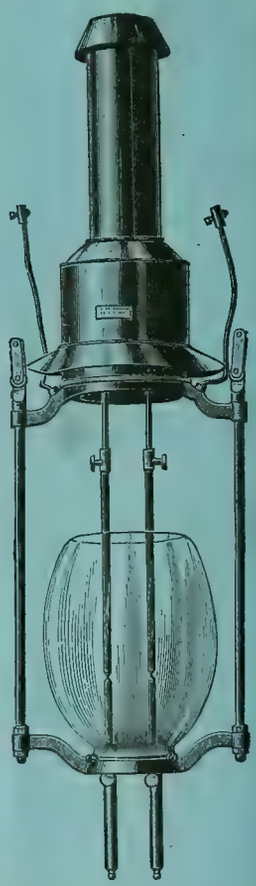

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Vol. I. CHICAGO, AUGUST 20, 1887. No. 8.

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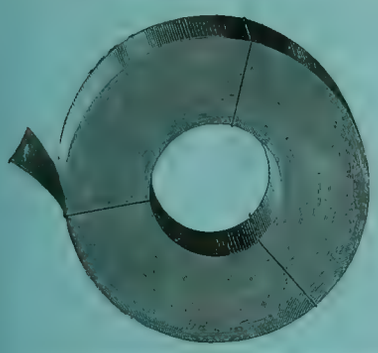

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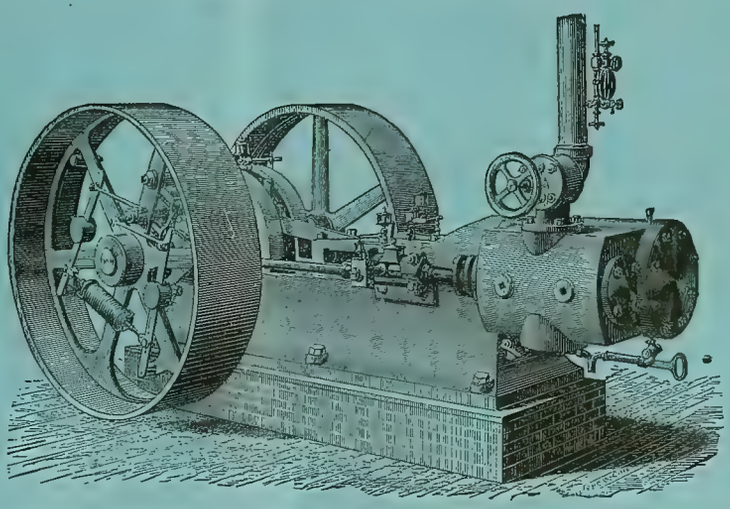
And other duty requiring close regulation of speed.



ADVANTAGES:

Great strength without excessive weight,
Small space required.
Simplicity of construction.
Accessibility of all parts.

ESTIMATES CHEERFULLY FURNISHED.

Western Office and Warerooms:

64 & 66 S. CANAL ST.,

CHICAGO., ILLS.

WM. A. HAMMETT, Mgr.

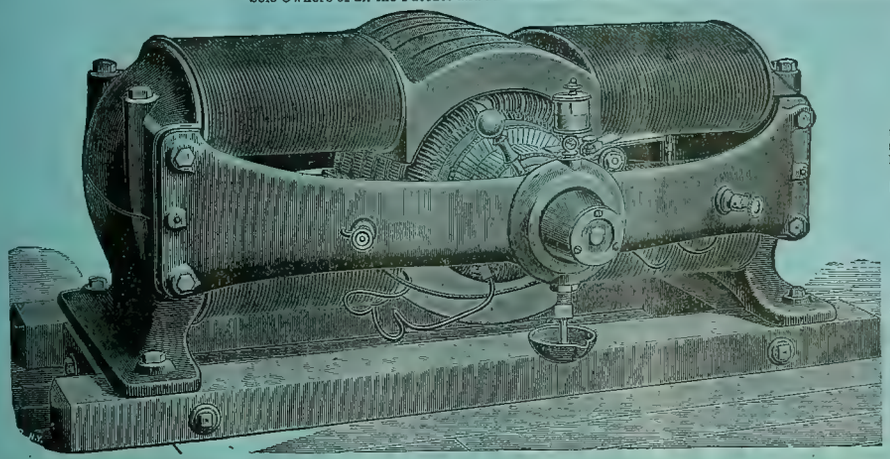
DANIEL W. MARMON, President.
ADDISON H. NORDYKE, Vice-President.

CHARLES D. JENNEY, Electrician

BRAINARD BORISON, Secretary.
AMOS K. HOLLOWELL, Treasurer.

JENNEY ELECTRIC COMPANY,

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp ❋ Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Arc-Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

Cor. Kentucky Ave. and Morris St. Indianapolis, Ind.

The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

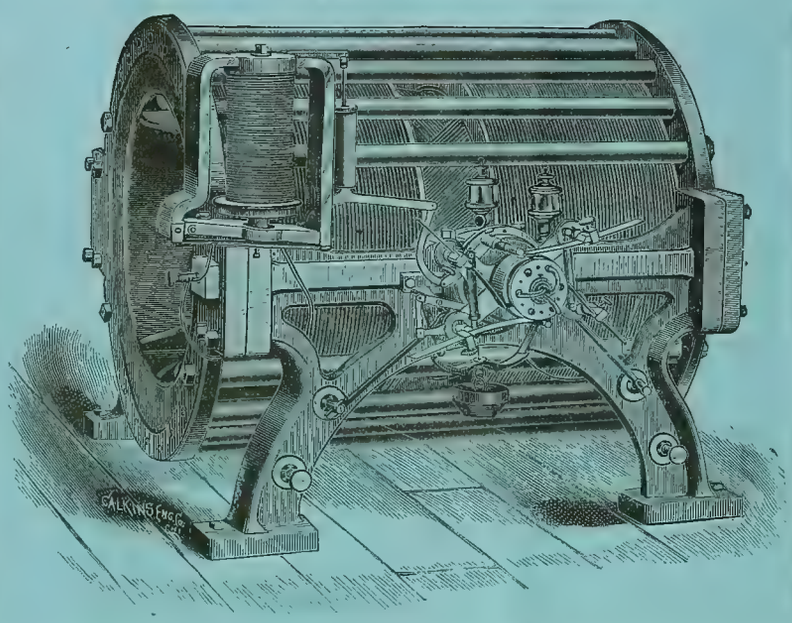
OF

Electric Arc-Lighting

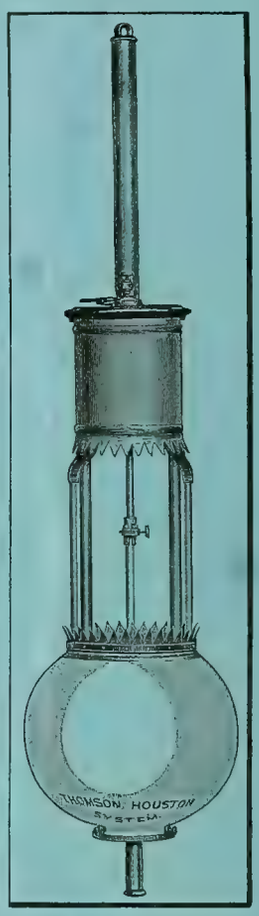
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

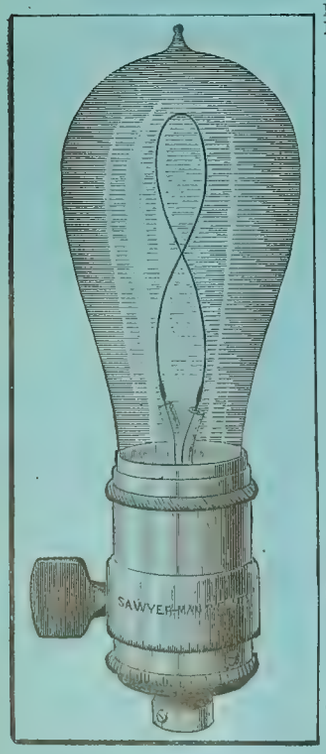


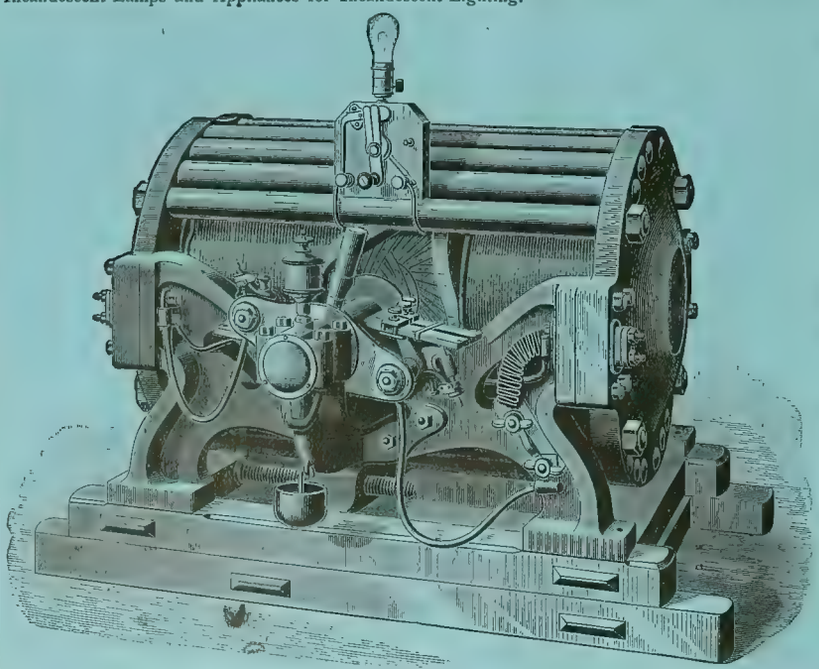
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufg. Co.

18 Cortlandt Street, NEW YORK.

For Simplicity of Construction, Steadiness and Purity of Light, Perfection of Automatic Regulation, Economy of Power in Operation, Freedom from getting out of Order, and Absolute Safety of Armatures from Burning,

THE AMERICAN DYNAMO HAS NO EQUAL

INTENDING PURCHASERS,

Whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS,

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

REYNOLDS' IMPROVED CORLISS.

THE IDEAL ENGINE FOR ELECTRIC LIGHT WORK.

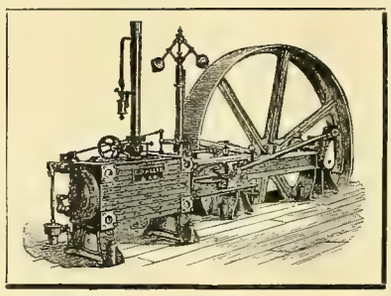
Unequaled for Close Regulation

—AND—

ECONOMY OF FUEL.

Write for our Catalogue and Circular giving List of Users.

SOLE BUILDERS



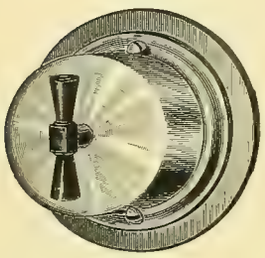
We refer to the following electric light plants now using the Reynolds' Corliss:
Brush Electric Light and Power Co., Cleveland, O.
Edison Electric Light and Power Co., Rockford, Ill.
Syracuse Electric Light Co., Syracuse, N. Y.
Louisiana Electric Light and Power Co., New Orleans, La., three engines.
Badger Illuminating Co., Milwaukee, Wis., two engines.
West Side Power Co., Minneapolis, Minn., four engines.
Louisville Electric Light Co., Louisville, Ky.
La Crosse Brush Electric Light and Power Co., La Crosse, Wis.
C., M. & St. P. R. R., Milwaukee, Wis.
Menominee Mining Co., Iron Mountain, Mich.
West Hotel, Minneapolis, Minn.
Plankinton House, Milwaukee. Wis.
N. W. Mutual Life Insurance Co., Milwaukee, Wis.
J. V. Farwell & Co., Chicago, Ill.
Chas. H. Slack, Chicago, Ill.
Mandel Brothers, Chicago, Ill.
C. Boetcher, Leadville, Col.
Omaha Thomson-Houston Electric Light Co., Omaha, Neb.
Thomson-Houston Electric Co., Racine, Wis.
Sioux Falls Electric Light and Power Co., Sioux Falls, Dakota.
Electric and Water Supply Co., Neillsville, Wis

EDW. P. ALLIS & CO., RELIANCE WORKS, MILWAUKEE, WIS.

CHICAGO BRANCH: 48 South Canal Street.

FOREST CITY ELECTRIC WORKS,

MANUFACTURERS OF

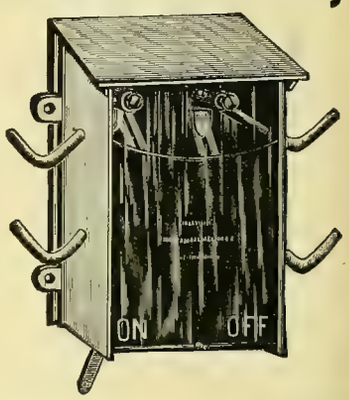


Cleveland's Electric Light Cut-outs,

GANG SWITCHES, FROM 5 TO 40 AMPORES.

Quick Make and Break Uncontrolled by the Handle.

Correspondence Solicited with Electric Light Companies.



W. B. CLEVELAND, Proprietor,

26 S. WATER STREET, CLEVELAND, O.

FARADAY CARBON COMPANY, LIMITED

CAPACITY, 1,000,000 CARBONS MONTHLY.

QUALITY GUARANTEED EQUAL TO ANY IN THE MARKET.

LOW PRICE LIBERAL DISCOUNT ON LARGE ORDERS. CORRESPONDENCE SOLICITED.

PITTSBURGH, PA.

J. J. DICKEY, President.
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ISRAEL LOVETT, Sup't and Electrician.

FLEMON DRAKE, Vice President.
L. H. KORTY, Treasurer.

MIDLAND ELECTRIC CO.

OMAHA, NEBRASKA,

DEALERS IN

ELECTRICAL SUPPLIES

FOR THE TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT.

Hotel and House Annunciators, Burglar Alarms, Fire Alarms, Electric Gas Lighting, Speaking Tubes, Elevator Annunciators, Batteries, Push Buttons, Electric Pens, Telegraph Learner's Instruments, Medical Batteries, Linemen's Tools, Bell Hanger's Supplies, Railway Velocipede Cars, Etc.

WESTERN AGENTS,—THE OKONITE CO., and the Return-Call System of Hotel Annunciators. Fire alarms for cities and towns.

We own the Franchises of the Western States and Territories, for the improved McCULLOH AMERICAN DISTRICT TELEGRAPH SYSTEM and are prepared to give franchises and construct plants on reasonable terms.

☞ Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. Illustrated Catalogue and Price List on Application.

EDISON

ELECTRIC LIGHT CO.

16 Broad Street, New York.

185 DEARBORN STREET, CHICAGO.

EDISON UNITED MFG. CO.

65 Fifth Ave., New York.

185 DEARBORN STREET, CHICAGO.

GENEVA ✦ NON-MAGNETIC ✦ WATCHES.

THE ONLY WATCHES MADE CONTAINING

Paillard's Patent Non-Magnetic Inoxydable Compensation Balance and Hair Spring,

WHICH ARE

UNINFLUENCED BY MAGNETISM OR ELECTRICITY

AND WHICH ARE ADJUSTED TO TEMPERATURE.

These Non-Magnetic Qualities are in the Movement (or Works) and Require No Shield or Other Protection.

Especially adapted to the use of employes of Electric Light and Telephone Companies, Engineers, Conductors, and all whose business calls them among the multiplicity of Electrical Devices.

ASK YOUR JEWELER TO SHOW THEM TO YOU.

GENEVA NON-MAGNETIC WATCH CO., Limited, General Offices, 177 and 179 Broadway, New York.

Send for Catalogue and mention this paper.

THE PARKER-RUSSELL MINING AND MFG. CO.

Electric Light Carbons

CITY OFFICE,

711 PINE STREET,

ST. LOUIS, MO.

ADAPTED TO ALL SYSTEMS.

Heisler ✦ Electric ✦ Light ✦ Company,

809 to 817 SOUTH 7th STREET, ST. LOUIS, MO.

MANUFACTURERS AND PATENTEES OF THE

Long Distance Incandescent Electric Light System,

CONTRACTORS FOR CENTRAL STATION PLANTS,

Call the attention of Arc Light Companies, Gas Companies, Municipal Authorities (particularly in towns without a Gas Plant) and parties having Steam and Water Power to the superior advantages of this system.

Combining Successfully the Illumination of the Streets with the universal supply of Incandescent Light to every Private House,

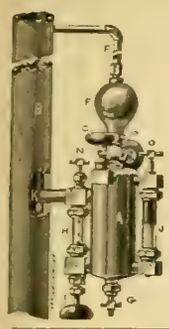
suited to comply with all the various demands of Commercial and Domestic life by the **most perfect Automatic Regulation,** with every facility for changing and shifting the circuits or extending the same to any desired distance at very small cost. This system has made **Central Station Lighting a practical success.**

Certain other advantages ensure the economical and profitable running of the Plants. The remarkable financial success that has attended the adoption of the HEISLER SYSTEM evidences this.

A large number of towns have adopted it for **general illumination** in lieu of Gas, circuits of **fifteen** to **twenty miles** and **even more** having been constructed for lighting the streets. IN SOME INSTANCES THE POWER STATION IS LOCATED OVER FIVE MILES FROM THE LAMP DISTRIBUTION.

Reference to the following Companies who have adopted the HEISLER SYSTEM is respectfully made and close investigation solicited.

BRUSH ELECTRIC LIGHT COMPANY, Cincinnati, Ohio.
CLEVELAND ELECTRIC LIGHT CO., Cleveland, Ohio.
LEAVENWORTH COAL CO., Leavenworth, Kan.
BRUSH ELECTRIC CO. OF VIRGINIA, Norfolk, Va.
SALT LAKE POWER, LIGHT & HEATING CO., Salt Lake City, Utah.
OGDEN ELECTRIC LIGHT CO., Ogden City, Utah.
PENDLETON ELECTRIC LIGHT CO., Pendleton, Oregon.
MANKATO ELECTRIC LIGHT CO., Mankato, Minn.
MONTICELLO ELECTRIC LIGHT CO., Monticello, Minn.
FERGUS FALLS ELECTRIC LIGHT CO., Fergus Falls, Minn.
MATTEAWAN ELECTRIC LIGHT CO., Matteawan, N. Y.
OTTAWA ELECTRIC LIGHT CO., Ottawa, Kan.
EUGENE ELECTRIC LIGHT CO., Eugene City, Oregon.
LIBERTY ELECTRIC LIGHT CO., Liberty, Mo.
KINGMAN ELECTRIC LIGHT CO., Kingman, Kan.
VINCENNES ELECTRIC LIGHT CO., Vincennes, Ind.
SAINT LOUIS ILLUMINATING CO., St. Louis, Mo.
Etc., Etc., Etc.



The Detroit Sight Feed Lubricators

Are pronounced the best by more than 20,000 users. They are especially adapted to

HIGH SPEED ENGINES FOR ELECTRIC LIGHTING

Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

Liberal discount to the trade. Send for Circular and Price List.

DETROIT LUBRICATOR CO.

Office, 11 Rowland Street, - DETROIT, MICH.

Our BELTING is tanned on the surfaces only; the

INTERIOR is RAW HIDE.

Send for Our Valuable Book for Engineers and Belt Users. Free.

Agents in all Cities. Send for Trial Belt.

Our Belts are the strongest, most even and perfect Electric Belts made.

ST. LOUIS, MO.

GEORGE P. BARTON,

Law Office

Rooms 68 and 69 TEMPLE COURT,

225 DEARBORN STREET, CHICAGO.

Patent and Trade-mark Cases.

Holmes, Booth & Haydens,

25 PARK PLACE, NEW YORK

MANUFACTURERS OF

Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

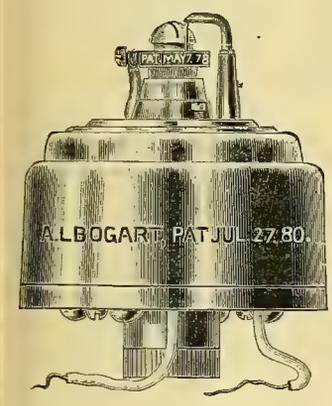
Western Agency, 185 & 187 Dearborn St., Chicago.

Headquarters for the West for all Kinds of Electrical Goods and Supplies.

WESTERN AGENTS FOR THE

A. L. Bogart's Electric Gas Lighting System.

SEND FOR PRICES.



WHOLESALE AND RETAIL DEALERS IN

Bells, Annunciators, Wire, Batteries, Etc.

ALOE'S

Improved Electric Watchman's Time Detectors,

The Best and Cheapest in the Market. TELEGRAPH and TELEPHONE SUPPLIES of every Description. ☞ Send for Our Illustrated Catalogue No. 20 of Electric Goods.

ESTIMATES CHEERFULLY FURNISHED.

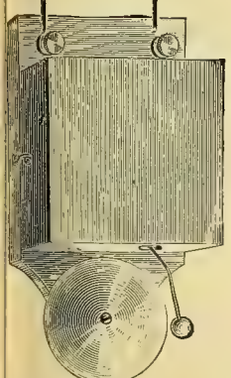
A. S. ALOE & CO.,

300 and 302 North Fourth Street, ST. LOUIS, MO.

HORACE VAN SANDS, ELECTRICAL SUPPLIES,

733 BROADWAY, NEW YORK.

Outfit, boxed for shipment, weighs 9½lbs.



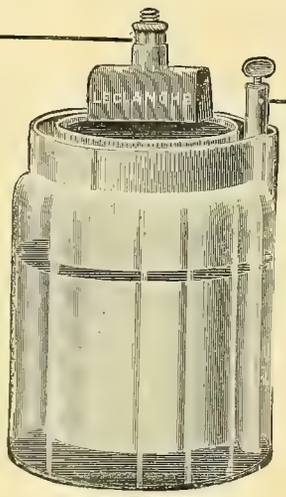
BELL.

$2.00

BELL OUTFIT.

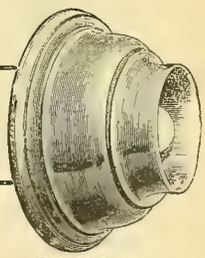
Bell	$1.00
Battery	.80
Push	.10
50 Feet of Wire	.15

BATTERY WILL LAST FOR THREE YEARS.



BATTERY.

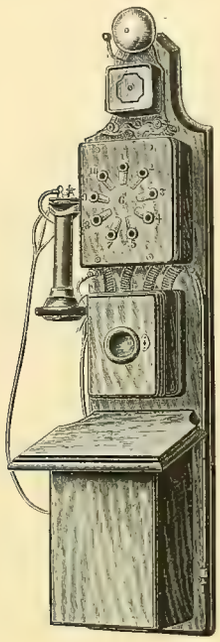
OUTFIT DELIVERED TO ANY PART OF THE CITY FREE.



PUSH BUTTON.

Send for Large Illustrated Catalogue Free to any address.

Western Electric Company



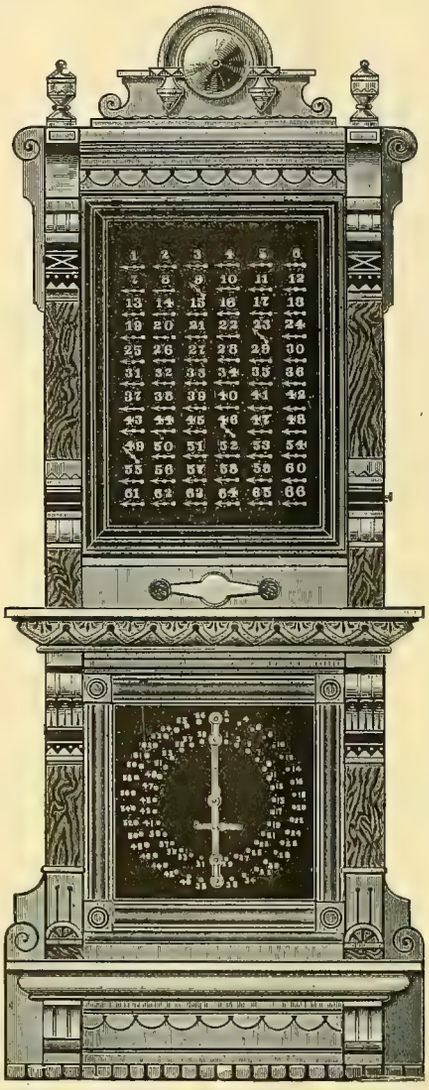
Every large building should have its

Telephone System.

By the use of our apparatus any number of rooms in any building, or the different departments of a factory, may be connected so that any one may signal and talk with any other without disturbing the rest. And connection may be made with the

City Exchange,

so that any room or department of a building can talk direct with any city subscriber. The above cut shows one of the ten stations in our Chicago Factory.



HOTEL ANNUNCIATOR,

Hotel Fire Alarm and Room Call.

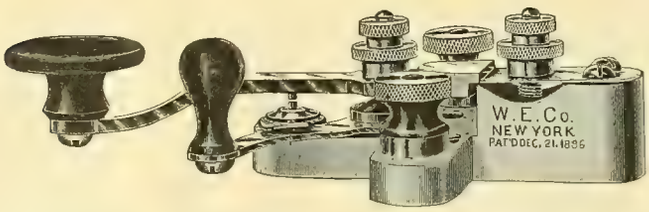
Our system for Hotel Calls and Return Calls, with Automatic Fire Alarm, requires so little battery for its perfect operation that it is the cheapest as well as the best in the market. It is the ONLY RELIABLE System.

ELEVATOR ANNUNCIATOR.

We were the first to apply a system of Electric Signals for Passenger Elevators, and we own patents which cover any and every device for communicating, by means of electricity, between a moving elevator and the different floors of a building.

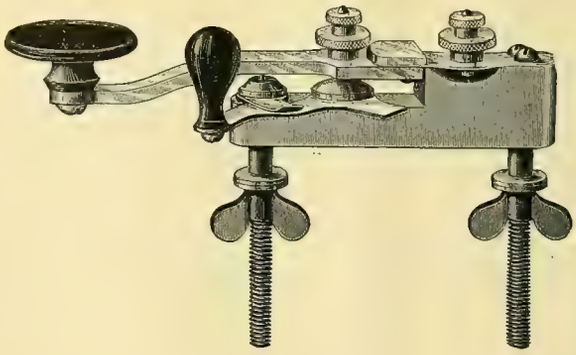
LE CLANCHE BATTERY.

We manufacture the LeClanche Battery that we sell, and guarantee it superior to any other in the market. We solicit orders direct, and are pleased to quote special prices on application.



The Steiner Key, with or without legs, is the best and cheapest in the market. We have abandoned the manufacture of all other patterns of Telegraph Keys.

Price, $2.00, subject to our usual discounts.



CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. I. CHICAGO, AUGUST 20, 1887. No. 8.

THE CONVENTION

OF THE

NATIONAL ELECTRIC LIGHT ASSOCIATION.

The sixth meeting of the National Electric Light Association, held in Boston, August 9th, 10th and 11th, was the most important and largely attended of any meeting in the history of the organization. We append a list of the officers for 1887-8, a list of the members and guests present, and follow with a stenographic report of the proceedings:

OFFICERS OF THE ASSOCIATION FOR 1887-8.

President—J. Frank Morrison, Baltimore, Md.

Vice-Presidents—E. R. Weeks, Kansas City, Mo.; A. J. DeCamp, Philadelphia, Pa.

Secretary—W. H Harding, Baltimore, Md.

Treasurer—Chas. Cooper, Brooklyn, N. Y.

Executive Committee—F. A. Gilbert, Boston, Mass.; Stephen Holbrook, Philadelphia, Pa.; M. M. M. Slattery, Woburn, Mass; Frank Ridlon, Boston, Mass.; J. F. Noonan, Paterson, N. J.; E. T. Lynch, Jr., New York, N. Y.; Geo. S. Bowen, Chicago, Ill; Dr. Otto Moses, New York, N. Y.

MEMBERS AND GUESTS PRESENT.

Alleghany County Light Co., Pittsburgh—S. A. Duncan, T. Carpenter Smith.

American Electrical Works, Providence, R. I.—P. C. Ackerman.

American Tool and Machine Co., Boston—W. H. Barker, E. E. Chandler, R. H. Stoyle.

American Watch Tool Co., Waltham, Mass.—C. J. Messer.

Andrews, Chas. H., Boston.

Armington & Sims Engine Co., Providence, R. I.—Gardiner C. Sims

Boston Electric Light Co., Boston, Mass.—Mayor Hugh O'Brien, F. A. Gilbert, P. Fahy.

Ball Electric Light Co., Boston—H. M. French.

Baker & Co., Newark, N. J.—C. O. Baker Jr.

Barnard, G. W., Boston.

Barton, S. E., Boston.

Baxter Electric Manfg. and Motor Co.—Benson M. Greene, Wm. Baxter Jr., David E. Evans, T. McCoubray.

Bergmann & Co., Boston—W. C. Livermore.

Bernstein Electric Light and Manfg. Co., Boston—Henry B. Cram, Oscar S. Bussman.

Bibber, Charles E., Boston.

Blake, W. H., Sawyer, Mass.

Blodgett Bros. & Co., Boston—A. D. Blodgett.

Boston Electric Protective Association—George W. Adams.

Boston Fire Underwriters Union—D. Killicutt.

Boston Rubber Shoe Co., Boston—G. L. Richard.

Bradley Electric Power Co., New York—C. L. Bradley.

Brady, T. H., New Britain, Conn.

Bridgeport Brass Co., Fred A. Mason.

Bridgeport Electric Light Co., Henry B. Stanley.

Brigham, W. V., Newton.

Brophy, W., Boston.

Brush Electric Light Co., Detroit, Mich.—W. W. Leggett.

Brush Electric Light Co., Norfolk, Va.—W. W. Chamberlain.

Brush Electric Co., Cleveland, Ohio—W. F. Swift.

Brush Electric Light Co., Philadelphia—A. J. DeCamp.

Brush Electric Light Co., Philadelphia—M. D. Lane.

Brush Electric Light and Power Co., Savannah, Ga.—T. P. Keck.

Cabot, F. E., Boston.

California Electric Light Co., San Francisco, Cal.—Geo. H. Roe.

Callender Insulating and Waterproofing Co., New York—A. W. Butterworth.

Campbell Electric Supply Co—Frank E. Clark.

Candee, John N., Poughkeepsie, N. Y.

Carhart, E. M., Providence, R. I.

Chandler, E. E., Boston.

Charlestown Gas Co., Charlestown, Mass.—Geo. B. Neal.

Chicago Arc Light & Power Co., Chicago—A. H. Brown.

Churchill, J. H, Boston.

Citizens Electric Illuminant Co., Brooklyn, N. Y.—E. F. Peck.

Clarke, Thos. W., Boston.

Cleveland Electric Motor Co.,—C. L. Wright, F E. Pettengill, Geo. W. Mansfield, J. J. Miller, Wm. Henderson, E. B. Gethune, Geo. W. Short, C. A. Brayton.

Cutter, H. W., Boston.

C. & C. Electric Motor Co., New York—H. S. Lutkin.

Dalzelle, J. A., Hartford.

Danbury Electric Light Co., Danbury—E. T. Wightman.

Daniels, A. T. C., Boston.

Darley, J. W., Baltimore, Md.

Davidson Steam Pump Co., Boston and New York—N. E. Park.

Davidson, W. F., Port Huron.

Day Kerite Wire & Cables—Ralph W. Pope.

Derby Gas Co., Birmingham, Conn.—Chas. A. Nettleton.

Dodge, James Hale, Boston.

Dowd, P. A., New York.

Dowd, F. C., New York.

Eastern Electric Cable Co., Boston. — Henry A. Clark, H. H. Eustis.

Edgar, C. L., New York.

Edgerton Electric Motor Co., Philadelphia—N. H. Edgerton, W. E. Sharp, W. B. Buchanan, Harry Hall.

Edson J. B., New York City.

Edwards, John R., Washington, D. C.

Elder Samuel, Boston, "American System."

Electrical Review, New York—Geo. Worthington, Chas. W. Price, A. V. Garratt, F. M. Gilley.

Electrical Accumulator Co. The, New York—Z. Latshaw, Prof. A. Reckenzaun.

Electric Construction and Supply Co. The, New York—F. E Kinsman.

Electrical World, The, New York—C. E. Stump, T. C. Martin, Joseph Wetzler, W. I. Barker.

Elgin Telephone Co., Elgin, Ill.—Wm. Hubbard.

Electrician & Electrical Engineer, New York—Geo. W. Phelps, Jr.

Empire City Electric Co., New York—W. Irwin Wark.

Enos Electric Railway Co., Boston—C. J. Messer, S. P. Messer, D. Gilbert Dexter.

Faraday Carbon Co., Pittsburgh, Pa.—Geo. F. Porter.

Fiberite Manfg. Co. Charles H. Brown.

Finley, N. D., Boston.

Fitch, Robert J., Boston.

Flanders, B. S., Boston.

Fleming, W. H., Liverpool, England.

Flint, John, Boooklyn, N. Y.

Fort Wayne "Jenney" Electric Light Co., Fort Wayne, Ind.—P. A. Randall, Edward Schaeffer, J. A. Jenney.

Fuller, Frank, Boston.

Geneva Non-Magnetic Watch Co., N. Y.,—A. C. Smith, Addison Conkling.

Gleason, E. P., Manfg. Co., New York—E. F. Gennert, Wm. F. Cullen, M. H. Gleason.

Globe Gas Light Co., Boston—D. W. Lee.

Greeley Electric Supply Co., New York—F. A. Magee, Miles W. Goodyear.

Groot, W. L., Orange.

Hall, W. A., Boston.

Hamblin, H. W., Pawtucket.

Harding, W. H., Baltimore, Md.

Harlem Lighting Co., N. Y.—John H. Hopgood.

Hartford Dynamic Co., Hartford, Conn.—Chas. H. Weed.

Hartwell, Geo. H., Boston.

Hatch, Jr., J. B., Boston.

Hawkeye Electric Manfg Co., N. Y.—Edgerton Bynne.

Hill, F. M., New York.

Hil, W. S., Boston.

Hillman, S. B., Philadalphia, Pa.

Howland, T. O., Boston.

Hutchins, W. F., Boston.

Hutchings, A. W., Boston.

Ireson, Charles L, Boston, Leather Link Belting.

Jamestown Electric Light Co., Jamestown, N. Y.—Thos. W. Smith

Jarvis Engineering Co., Boston, Mass.—A. F. Upton, Boston; J. N. Pratt, New York; H. A. Glasier, Chicago.

John T. Noye Manfg. Co., Buffalo, N. Y.—A. A. Noye.

Jones & Bros. Electrical Works, Cincinnati, Ohio—F. Amos Kelly.

Julien Electric Co., New York—C. O. Mailloux, J. L. Kimball, G. F. Galcott.

Kansas City Electric Light Co., Kansas City—E. R. Weeks.

Kellogg, B. W., Boston.

Kerr, W. C., Pittsburgh.

Learing, Lewis, Mew York.

Leavitt, Thos., Boston.

Lewiston & Auburn Electric Light Co., Auburn—N. J. Jordan.

Lockie Patent Damper Regulator, Springfield, Mass.—C. C, Webber.

Lockwood, Thos. D., Boston.

Louisiana Electric Light & Power Co., New Orleans, La.—Samuel J. Hart.

Lytle, H. B., Providence, R. I.

Malden Electric Light Co.. Malden, Mass.—A. E. Bliss.

Martin, John B., Boston.

Mather Electric Co., Chicago—J. H. Reid.

McCallum, A., Northampton, Mass.

Mendell, W. H., Boston.

Merideth, Irving S., Boston.

Millville Electric Light Co., Millville, N.J.—Stephen Holbrook.

Mitchell, D. L., Taunton.

Modern Light and Heat, Boston—C. M. Ransom, R. F. Ross.

Monford, J., Bridgeport, Conn.

Moses, Dr. Otto A., New York.

Mullen, Edwin D., Philadelphia.

Municipal Electric Light Co., Brooklyn, N. Y.—Charles Cooper.

Munson & Co., Chicago—J. H. Shay, J. H. Thomas.

National Carbon Co, Cleveland, O.—W. H. Lawrence, W. C. Hayes, C. D. Smith.

New Bedford Electric Light Co., New Bedford, Mass.—William Lewis.

New Bedford Gas Light Co., New Bedford, Mass.—Gilbert Allen, Robert B. Taber.

New England Telephone Co., Boston—A. H. Chapman, F. J Boynton.

New England Wiring Co., Boston—W. J. Paine, H B. Prindle.

New Haven Electric Light Co.—Jas English.

Newton Electric Light & Power Co., Newton, Mass.—H. G. Pratt, H. H. Cutler.

New York Electrical Construction Co.—F. G. Cartwright.

New York Electric Light Co., New York—J. W. Pendleton.

New York Insulated Wire Co., New York—J. W. Godfrey.

North Attleboro Steam Electrical Co.—H. M. Daggett, Jr., L. W. Dillon.

Noble, Edmund, Boston.

Okonite Co., The, New York—Geo. T. Manson, Willard L. Candee.

Packard, M. M., Baltimore, Md.

Parker-Russell Mining and Manfg Co., St. Louis—G. W. Parker, D. R. Russell.

Patten, J. F., Duluth, Minn.

Pierce, C. H., Northampton, Mass.

Phillips, E. P., Providence, R. I.

Powers, G. C., Panama R. R.

Powers, C. W., Boston.

Powers, J. C., Troy, N. Y.

Prentiss, R. W., Prof. Columbia university.

Priest, B. E., Boston.

Rand, C. W., Boston.

Rand, W. M., Lynn, Mass.

Razee, R. E., Mansfield.

Richmond Carbon Co., North Adams—C. T. Richmond, G. Richmond.

Richardson, G., Boston.

Richardson, Jr., S. O., Boston.

Riverside & Oswego Mills, Providence, R. I.—R. T. Robinson, W. A. Huse.

Rogers Auxiliary Fire Alarm, Boston—Otis N. Howland, S. P. Wardell, G. W Daniel.

Ross, G. S., Boston.

Royce, Frederick, Washington, D. C.

Ryan, R. W., New York.

Russell, A. L., Boston.

Russell Engine Co., Meriden, O.—C. A. Gates.

Sautey, J. P., Boston.

Sawyer-Man Electric Co., N. Y.—Gen. C. H. Barney, P. H. Alexander, H. S. Thornberry, A. G. McCluer, T. C. Frenyear, Henry C. Davis, E. H. Thompson, F. E. Alexander, E. C. Angell.

Schuyler Electric Manfg. Co., Hartford, Conn.—M. J. Wightman, J. H. Dalzelle.

Scoville Manfg. Co., Waterbury, Conn.—Leonard Waldo.

Scranton Electric Light Co., Scranton—Robert Reaves.

Simplex Electrical Co., Boston, Mass.—A. F. Mason, A. C. Pond, E. H. Batcheler.

Sims, Thomas C., Boston.

Somerville Electric Light Co., Somerville, Mass.—H. F. Watts.

South Bend Electric Co., South Bend, Indiana—J. Dutham.

Southwark Foundry and Machine Co., Philadelphia—James A. Pentz.

Sparrow, E. P., Boston.

Spaulding, E. S.
Sprague Electric Motor Co., Boston—A. F. Starkey.
Sprague Electric Railway & Motor Co.—F. J. Sawyer, Edward Blake, of Boston.
Standard Carbon Co., Cleveland, Ohio—J. B. Crouse, D. A. Dangler, W. H. Boulton.
Standard Underground Cable Co., New York—G. L. Wiley.
Steuart, Arthur, Baltimore, Md.
St. Joseph's Electric Light & Power Co., St. Joseph, Mo.—W. C. Stewart.
Stockbridge, G. H., New York.
Sun Electric Co., Woburn, Mass.—Frank Ridlon, M. M. M. Slattery, J. E. Talbot.
Syracuse Eiectric Light Co., Syracuse, New York—A. P. Seymour.
Thomson-Houston Electric Co., Boston, Mass.—Elihu Thomson, Chas. A. Coffin, S. A. Barton, W. B. Hosmer, T. P. Bailey, E. W. Rice, H. W. Burgett, P. H. Alexander, H. N. Curtis, G. W. Davenport, A. S. Rohrer, W. R. Kimball.
Thomson-Houston Electric Co, Chicago—G. W. Atkinson, F. H. Goden.
Thomson-Houston Electric Light Co., Kansas City—Theo. P. Bailey, Chas. S. Rusling.
Toland, Hugh J., Supt. of Lamps Boston.
United Electric Co., Springfield, Mass.—J. W. Hyde.
U. S. Electric Co., Baltimore, Md.—P. O. Keilholtz.
U. S. Illuminating Co., N. Y.—E. T. Lynch, jr.
Vitrite & Luminoid Co., New York—Romaine Mace.
Waite, Williams & Co., Boston—Geo. W. Waite, E. H. Williams, C. Niles Goward.
Weil, Henry J., Boston.
Western Electric Co., New York and Chicago—F. W. Harrington.
WESTERN ELECTRICIAN, Chicago—W. A. Kreidler.
Westinghouse, Church, Kerr & Co., New York—Isaac H. Davis.
Westinghouse Electric Co.—Kerr, Walter C., Stanley, jr., Wm. Wright, Alex. P.
Whittier, R. H., Providence, R. I.
Wightman, E. T., Danbury.
Wightman, M. J., Hartford.
Williamson, John J., Boston, Mass.
Willington, W., New York.
Wist, Herbert C., Boston.
Woodbury, C. J. H., Boston.
Worcester Electric Light Co., Worcester, Mass.—H. H. Fairbanks.
Wright, L. B., Boston.

TUESDAY MORNING'S SESSION.

The convention was called to order at 10:30 o'clock, at the Parker House, by President Morrison who spoke as follows:

PRESIDENT MORRISON'S ADDRESS.

Gentlemen of the National Electric Light Association: I have again to congratulate you upon the success of your organization which the large attendance to-day from all over the country evidences. Inventive ability and irrepressible energy of the most pronounced character, still further encourages us in the belief that if electrical business does not achieve a phenomenal success, it shall not be for want of intellectual activity, energy and integrity,

Great progress has been made in the last six months in electric lighting generally, but especially in the development of incandescent systems. The induction system which permits of low tension lamps, at a great distance from the station, is a branch of lighting that has greatly increased since the last convention, and is now successfully conducted in numerous places. This system, more than any other formerly in use, is designed to find its place in the illumination of private houses. Its flexibility is very great. Its farther development is encouraging.

Lighting by storage batteries has also received a great impetus within the last three months, and while there are still some difficulties to overcome in certain branches of illumination, it is fast superseding the dangerous oil lamp on railway trains.

Dynamos have been perfected, so as to give greater efficiency per pound of metal used, and our electricians are constantly working to reduce the cost of the machines, and thereby insure a large market for the same.

The perfection of the arc lamp has increased, and the demand for the same in the last six months exceeds the output of the previous eighteen months.

Mill owners and others are beginning to realize the enormous advantages of the electrical illuminant, not only in the more healthful condition of the operative, but also in the greatly decreased fire risks. The underwriters throughout the country recommend the introduction of incandescent lights to their patrons, in all factories where inflammable fabrics are made.

Abroad, the introduction of electrical installations has been slow and unsatisfactory, but of late our brethren across the ocean have taken up the subject with vigor, and to-day are becoming formidable rivals in the enterprising spirit of this country in the adoption of electric energy for all uses.

The patent office question, perplexing and unsatisfactory, as we are well aware, is now receiving attention through the agitation of the subject by this association, and we intend to keep this matter before the world until legislation shall be compelled to furnish what is needful.

As suggestive of the multiplicity of uses to which electricity may be put, Lieut. Murdock submits a paper setting forth and explaining the electrical requirements for the new Government cruisers; and although this especial electrical application would necessarily be limited it would no doubt be useful, and still farther evidences the desire and demand for the applications of electrical devices in every branch of industry.

The perplexing wire gauge matter will again be placed before you, and if the work of the past six months of the Committee on this subject, corresponds with the exhaustive and excellent report made at the last convention, we may expect something definite enough this time to decide the attitude of this Association in relation thereto.

I regret to have to announce the absence of the report of the committee on insulation of wire and the proper installation and construction of plant. This Committee requested the Association to provide the necessary means to enable them to carry out their investigation. But, as the Association was in no condition to render them the pecuniary aid they required, they determined not to pursue their work any farther. I believe this to be a loss to the Association; as from the statements they have made of what they intended to do, if they only had the means, I can easily foresee the loss of a great deal of valuable information to ourselves and to the world at large.

I have now the honor of introducing to this Association one of the most popular mayors that the city of Boston has ever had. A gentleman who represents public interests more than the interests of any particular party or clique, and who under the most trying circumstances has shown his fidelity as a public representative to such an extent as shall make his official administration one of the most memorable landmarks in the history of Boston's progress.

At the close of the address the president introduced Mayor O'Brien, of Boston, who was received with applause.

MAYOR O'BRIEN'S ADDRESS.

Mr. President and Gentlemen of the National Electric Light Association:—You almost overcome me, Mr. President, by your very flattering remarks; but it gives the mayor of Boston great pleasure to welcome so many distinguished gentlemen to the city who are engaged in a very important work. I hope your visit will be a pleasant one, as also a profitable one, and if you can show us any way whereby we can light our streets and dwellings better than the work is now done, we shall be very thankful to you, Mr. President, and your association.

I read in the papers a few weeks ago that immense fortunes were made in the electric lighting business. It must be a very attractive business, and I suppose now that I am addressing men not only engaged in electric lighting work, but millionaires of various degrees. [Laughter.] Our experience in Boston does not, I am sorry to say, corroborate that fact. Electric lighting, so far, has been introduced by the energy, the ability, and the intelligence of men who have been engaged in local lighting. I believe it is their intelligence that has scattered the electric light over the country in such large proportions in every city and many of the towns and counties. So far, I believe, profits have not been very equally divided. Some few men, I have no doubt, have grown rich in the electric lighting business; but I am satisfied that every man who has started a local company, either in this city or in any other city of the country, has been a more public benefactor than one who made any pecuniary benefit from his work. I do not intend, gentlemen, to advise you, or say anything about the work which you are engaged in. I have no doubt your discussions will be interesting, and I hope that your visit to Boston will be a pleasant and agreeable one. I know it must be very satisfactory to many of you coming from cities and towns where the thermometer ranges up to the hundreds to visit so delightful a city as we have here in Boston, where you can enjoy good fresh air at about 65. [Laughter.] And if you have time, it would give me pleasure to take you down our beautiful harbor and into our beautiful suburbs, and I hope you will not leave Boston before you visit each of these places.

If you can give us any advice about the electric motor we should be very much obliged to you. We have street-car lines running in all directions, and we would like to run them by electric motors, but the experience of electric lighting men in these parts shows that experiments are very expensive, and we hope that some of you who are running electric railroad motors in other sections of the country will give us some intelligent advice on that subject. We also believe in the motor business here. Boston has neglected small industries. I believe if you establish a motor that will do the work, that you will enable us to build up a great many small industries that have been neglected in the city of Boston.

I will not detain you any longer, gentlemen, but I again hope that your visit to Boston will be a pleasant to you all. [Applause.]

The secretary read reports of the secretary and treasurer which, on motion, were referred to the Executive committee for verification.

The president then called for the report on legislation.

MR. STEUART: I have the honor to make the report of the legal committee, as well as the report of the committee appointed at the February meeting in Philadelphia—a special committee on "Patent Legislation." At that meeting I had the honor to read a paper upon the necessary reforms in the patent system, particularly with reference to those reforms that were needed in the patent office, and I pointed out at that time numerous changes that were thought necessary in the patent office. The principal among them was the establishment in the patent office of a court that would embody in itself the jurisdiction that is now divided among half a dozen different officers all of whom are acting to a greater or less extent at cross purposes with one another. The second subject which was considered was that of the increased caliber of the personnel of the office; and some systems were suggested. The third was the increase of space in the patent office and the establishment of a laboratory for the conduct of experiments, principally electrical, which are very much needed, and we had the pleasure of having a few words from Mr. Kintner who was at that time the examiner-in chief of the electrical division, since resigned, in which he set before you very clearly the very great need of the office in that particular, there being absolutely no laboratory or any apparatus of any consequence—he said not over five hundred dollars' worth, in all—to test the inventions which are constantly increasing and which require to be tested in order to be understood.

Mr. Steuart then presented the

REPORT OF THE LEGAL COMMITTEE ON PATENT LEGISLATION:

At the February meeting of this association, your Legal committee made a report in which were set our some of the present needs of the United States Patent office; and suggested a means by which the needs might be met and the defects remedied.

The subject being one of great importance, a special committee upon "Patent Legislation" was appointed, consisting of J. F. Morrison, Baltimore; Walter C. Kerr, New York; Frank Ridlon, Boston; J. F. Sprague, New York, and Arthur Steuart Baltimore, the chairman of the legal committee, to further consider the questions presented, and make a full report of this convention. Your committee has given this matter careful consideration and report that they are convinced that that branch of the patent system which relates to the granting of patents, is based upon a law which was formulated at a time when the mass of business to which it was applicable was one-fiftieth part of what it is at present, and that the law needs revision in the following particulars, among others:

1. The statute law of the United States relative to the granting of patents has very few provisions which determine the rights of applicants. The result is that nearly all the vital questions, both of law and fact, by which the rights of applicants for patents are to be determined, now lie within the jurisdiction of the various branches of the Patent office. The examiners have nearly all questions of fact to determine primarily as well as many questions of law, and their jurisdiction is divided up among a number of junior examiners who are overburdened with work. The examiner of interferences sits as a court to determine the question of priority between contestants for patent on the same invention. From the primary examiners, cases go on appeal to a board of examiners-in-chief and from there to the commissioner, and appeals from examiner of interferences go to the commissioner. The *personelle* of the office is constantly changing, the commissioners more often than others. Then, too, the persons who are appointed to the position of commissioner are generally chosen for some reason that has no connection with patent law, so that as a general rule the highest appellate tribunal knows less about the law and practice of the patent office and the rules by which patent cases are to be decided than the examiner from whom the first appeal is taken. This being true, it is not surprising that the examiners pay comparatively little respect to the decisions of the commissioner, and also that one green commissioner following another in quick succession should make rulings which result in a hopeless chaos in the practice. In addition to this fact the commissioner is burdened with executive duties which demand so much of his time, that with the greatest experience and power of work, it is impossible for him to properly consider the numerous important cases presented for his decision.

In order that the legal rights of patentees may be fully defined and secured, it is necessary that those rights should be understood and a settled method of obtaining them established; for this reason, it is desirable that some means should be adopted to make clear and uniform the practice of the Patent office.

All authorities seem to agree that the best method of accomplishing this result is to establish a strong court in the Patent office that shall have jurisdiction of all legal questions arising in relation to the issuance of patents as well as all questions of fact which arise in interference proceedings and on appeal from the examiners.

II. The work required of the examiners in the Patent office is of such a technical nature and so important to the public that it seems to be desirable that the Patent office should be put on the same footing as the army and navy; that the examiners should be educated for the service, should receive compensation equal in corresponding positions to the officers of the army and navy, should have the same system of admission and promotion upon examination and retirement on pay equal to that of those departments of the public service.

III. The Patent office is now cramped for space, the employes are crowded into quarters half large enough for them, and the Patent office building, built with money paid the government by patentees, is more than half occupied by the Interior department, which should have separate accommodations. Additional space would enable the Patent office to have a laboratory, so much needed, for the demonstration of electrical and other scientific discoveries and inventions.

To accomplish these reforms, the most cautious, expeditious, and at the same time intelligent way, seems to be, the creation of a commission to be appointed by the president, which shall carefully examine these and all other questions relative to the subject, and report an act to congress which will provide for their solution. We suggest the following bill, which we propose shall be submitted to congress this winter for passage:

A BILL, CREATING A COMMISSION TO EXAMINE AND REPORT TO CONGRESS NEEDFUL REFORMS IN THE PATENT LAWS.

Whereas, the Patent laws of the United States are deemed to be in such a condition as to require revision, therefore,

Be it enacted, by the senate and house of representatives of the United States in congress assembled:

SECTION 1. That the commission be, and the same is hereby created, to consist of three suitable persons to be appointed by the president of the United States, who shall hold office until a final report of this commission is submitted to and accepted by congress. And who shall receive for their services a compensation of $5,000 each, per annum.

SECTION 2. It shall be the duty of this commission to examine thoroughly the present Patent law of the United States, and those of other countries, and their practical operation and effect, in meeting the needs of the public, and fulfilling the purposes for which they were created. To formulate a report to be submitted to congress which shall set forth the results of this investigation and their conclusions therefrom, with reference to changes in or additions to the present law, pertaining to patents. This report shall also contain a draft of an act which will provide for the changes found necessary by the investigations of the commission.

SECTION 3. The commission is authorized to employ such clerical force as may be necessary for the proper conduct of its work and to incur such other expenses for stationery, printing, etc., as may be found expedient.

SECTION 4. The salaries of the members of this commission as well as all expenses legitimately incident to its work, shall be paid from the surplus in the United States treasury, to the credit of the Patent office. All expenditures by or for said commission, other than the salaries of the members, shall, however, be under the control of and authorized by the secretary of the interior.

One word I would say for the information of those who may doubt the possibility of obtaining this result, it will cost some twenty-five thousand dollars, or at least twenty thousand dollars, because it is going to take the labor of competent men and require a great deal of time to work up the thing in proper shape. As a justification for making that proposition to congress, the committee would say that there is now lying in the United States treasury something over three millions of dollars to the credit of the Patent office, that has been paid there by patentees, and that has not been expended in the support of the present Patent office as it exists.

And now a duty devolves upon the members of the association. It is one thing for your committee to make this report, but a totally different thing to have it passed by congress. That result can, however, be accomplished if the members of the association will intelligently and faithfully support the hands of their committee, by themselves, each one of them, doing the part of the work assigned him to do. This association represents twenty-four states, and members of this association are fellow townsmen with eighty members of the house and senate, while the members of the house and senate from the states represented in the association are sixty-one per cent. of all the members of congress. The committee have divided up the members of congress among you; and assigned to each the duty of seeing the members of congress from his state and urging upon them the importance of the passage of this bill. Its passage lies in your hands.

The committee think it very desirable that the next meeting of the association be held in the city of Washington. The location is central, and congress will be in session at that time. The members of congress will have an opportunity of seeing how large and important an interest is calling upon them for action, and the members of the association can take the opportunity of waiting upon their representatives in congress and urging the passage of the bill we present for the appointment of the commission.

Present at the meeting of committee, July 21st, 1887, at office of *Electrical Review*, New York, J. F. Morriton, Frank Ridlon, Walter C. Kerr, F. J. Sprague, Arthur Steuart, Chairman.

I have only one other word to say in connection with a report which I shall submit in writing of the legal bureau of which I have the honor to be the custodian. The report will give a sketch of the work that is being done. A digest is in course of preparation, covering the literature of electric lighting. We have at our command at present, a set of journals and books which I suppose are not to be found anywhere in this country save in Baltimore. We believe that this analytical digest of the literature of electric lighting which we are preparing will be useful to the association.

REPORT OF LEGAL BUREAU.

The custodian of the legal bureau would report that in the near future he expects to be able to offer to the members the use of an analytical digest of patents, as well as the literature of electric lighting and subjects collateral to it, that will make it possible to determine with great accuracy as well as expedition the exact state of the art in any department, and hence the validity and scope, as far as such can be determined in the absence of judicial determination, of any patent that may be submitted for examination. The digest will embrace all United States patents on electric lighting and collateral subjects;

English patents;

French patents as far as they can be obtained;

And the following publications:—

1. *American Academy Arts and Sciences*, old series volumes 11 to 17, and new series from volume 3 to last number.
2. *American Association for the Advancement of Science*, from volume 1 to last number.
3. *American Journal of Science*, from 1819 to last number.
4. *American Engineer*, from volume 2 to last number.
5. *Annalen de Chemie et de Physique*, volume one to last number.
6. *Associated English Society*, volume 1 to last number.
7. *British Association for Advancement of Science*, volume 1 to last number.
8. *Canada Royal Society*, volume 1 to last number.
9. *Canadian Science Record*, volume 1 to last number.
10. *Constralblatt fur Electritechnik*, from volume 5 to last number.
11. *Electrical Review*, volume 1 to last number.
12. *Electrical World*, volume 1 to last number.
13. *Electrician* (London), from November 1st, 1880, to last number.
14. *Electrician* (N. Y.), from volume 1 to last number.
15. *Electrician and Electrical Engineer*, volume 1 to last number
16. *L'Electricete*, from 1880 to last number.
17. *Journal Franklin Institute*, from volume 1 to last number.
18. *Industrial Review*, from volume 1 to last number.
19. *Jahreshcicht uber Chemie und Physik*, from 1822 to last number.
20. *Journal de l'Ecole Poletechnique*, volume 1 to last number.
21. *Journal de Physique*, 1872 to last number.
22. *London Philosophical Magazine*, from 1798 to last number.
23. *Journal Royal Society*, from 1830 to last number.
24. *Journal Society Telegraphic Engineers*, from 1883 to last number.
25. *La Lumiere Electrique*, from volume 3 to last number.
26. *Nature* (London), volume 13 to last number.
27. *Comptes Rendus*, volume 1 to last number.
28. *Poggendorff's Annalen*, volume 1 to last number.
29. *Science Record*, volume 1 to last number.
30. *Scientific American and Supplement*, from 1879 to last number.
31. *Telegraphic Journal and Electrical Review*, from October, 1876, to last number.
32. *Science* volume 1 to last number.
33. *Zeitschleft fur Instrumenden Kunde*, volume 1 to last number.

In addition to the foregoing, such books will be added as are found of value.

On Mr Ridlon's motion, seconded by Mr. Lynch, the report of committee was accepted, and the committee continued and authorized to take such steps, not involving expense to the association, that they might find necessary to have this bill as presented passed by congress.

The PRESIDENT: The report of the committee on Revision of the Constitution will be presented by Mr. DeCamp.

Mr. DECAMP: In looking over the reports of the various meetings it appears that there have been several amendments made to the constitution which we have printed that change it entirely. Therefore we have thought fit to submit an entirely new constitution as a substitute for that which was originally adopted and I now lay it before you.

The secretary read the report of the committee, and a motion was made and seconded to accept it.

Mr. DECAMP: There is one thing occurred to my mind there in the reading of that report which is an error; that is in the part that refers to the treasurer, which should read: "may be one and the same person"

Mr. LEGGETT: I would like to inquire what is the meaning of the clause relative to the annual dues. Suppose a company should organize at the present time, would they have to pay their annual dues from the time of the organization until the time they enter, or do they start from the time they apply?

The PRESIDENT: They start from the time they apply If they join on the last day of the calendar year, according to this they would be compelled to pay their membership fee and dues, being twenty dollars; thereafter ten dollars a year, and the ten dollars will cover the calendar year.

The subject matter was taken up *seriatim*, to stand approved unless objected to.

The secretary read the first and second articles.

Mr. GARRATT: I move that the number 3 in section 2, be changed to 4.

Mr. PHELPS: What is the subject of the amendment?

Mr. GARRATT: My object is this: Oftentimes manufacturing companies find it necessary to send several gentlemen to these conventions to properly take care of their exhibits and their business. Some one in that event, of the number, will have to be left out of the association. I see no element of danger to the association in having four men pulling on one rope in this convention. If there is any, I should like to have it stated, because it is an important question I think, however, there will be many concerns, and there are many at present, who would like to make four men members of this association. not so much for the purpose of their votes as for the purpose of having the men inside the association. I think five would be a little too many, and I think three a little too few

Mr. Garratt's amendment was adopted.

Mr. DUNCAN: I would like to inquire what is meant by supplies; what does the representatives of supplies mean there?

The PRESIDENT: It means wire, carbon—all the materials that enter into the making a plant.

Mr. DUNCAN: It is a very ambiguous clause, it seems to me.

The PRESIDENT: It makes it all the more elastic. I presume that was the intention—to make it elastic, so that all those engaged in business who desire to become connected with the association could reach it in some way.

The secretary read the remainder of the amended constitution.

Mr. SMITH, of the Allegheny County Light Co.: I should like to ask in reference to the section which speaks about the members, if that is intended to include oil men and people who furnish supplies of that kind; because if the object is to make it as elastic as possible, we had better throw out the word electric lighting, as that might scare off some people who would like to be members. It seems to me that if this is an electric light association, we ought to draw the line somewhere.

Mr. DUNCAN: I move, sir, to recommit that report to the committee for the reason that in the first place they were not authorized to prepare a new constitution. They were simply authorized to prepare such amendments as they might see fit to incorporate. In the next place, it takes a two-thirds vote of this association to adopt an amendment. In the next place they have changed the constitution to such an extent as to center the whole power of this organization in the president—not that I have any objection to the personnel of the president whatever, but I have objection to the centralization of power. It says in this new constitution that the secretary and treasurer may be one man, and in another section that that one man may be removed at the will of the president. It seems this association can arrange those officers in such a way as not to place the organization in a position of that kind, and for those three reasons I move to recommit that report.

The motion was seconded by several members.

Mr. MORRISON—Vice-president Weeks in the chair—: The principal objection which Mr. Duncan refers to seems to me to be the centralization of power. There seems, however, to have been no objection to the centralization of labor [laughter]. The work of this association has been done in the main by those who are brought immediately in contact with the president. That part of the work which is left outside of that has generally been left undone, except in two notable cases—Mr. DeCamp and Mr. Gilbert. It is impossible to appoint a secretary of this association in Chicago and a president in Baltimore and a treasurer in Boston, and have the business transacted in such a way as will be satisfactory to the association. At your Detroit meeting, I was very anxious to be relieved of the duties of president of the National Electric Light association, and those of you who were present at that meeting—I was not present myself and had telegraphed my resignation—those of you who were present at that meeting are fully aware of the steps then taken to bring about this exact condition of things. This report, I presume, was gotten up hurriedly, and there are other and graver objections to my mind than that of the centralization of power. What you want in the government of an association of this sort is—the centralization of power, so far as you can trust the men in whose hands you place it. A scattered, diffusive authority in an association of this kind will result in the death of the association in about twelve months. It requires rather strong government to hold together such an association as this, and if divested of the supply and the oil men that Mr. Smith refers to, you would not have enough money contributed by men actually engaged in the electric lighting business to pay the rent of this hall two weeks. There are all these elements entering into the general make-up of the National Electric Light association, and it is only by a strong, closely governed arrangement that you can hold your people together, and bring about the condition of things which we are all striving for, which is the dissemination of information in our line.

The sixth article which says that the annual meeting and the semi-annual meeting shall be held at such places as the Executive committee shall determine, I object to. In my judgment the place of meeting of the National Electric Light Association, should be determined by all its members in council, and not by the Executive committee. I believe, and I think it is the general impression, that almost any city of this country will be proud to have this association meet within its limits. Mr. Steuart, in his very able paper, on another subject, has called your attention to the fact that twenty-six States are represented in the National Electric Light Association. With that broad representation I should say that the designation of a place at which your various meetings shall be held ought to be done in the body of the convention.

Article seven is not sufficiently distinct; the case is not clearly enough stated. The entrance fee shall be ten dollars for each member; the annual dues shall be ten dollars, payable in advance, and shall cover the calendar year—I should put it in somewhat plainer language. I am not yet prepared to suggest any amendment. The fact that the constitution prescribes a line of duty for the president and all the other officers brings their conduct directly under the hands of this convention. As to the objection that this is a substitute for the constitution laid before the committee, I would say that the substitute may be adopted as an amendment to the original constitution by that vote which Mr. Duncan speaks of, that is, a two-thirds vote of the members present.

Mr. COOPER: I would amend the proposition to report back to the committee to this extent, that they report to some other meeting of this session.

Mr. DUNCAN: I want to call the attention of the convention to the incongruity of that report; I simply wanted to raise the question.

Mr. COOPER: I thoroughly agree with Mr. Morrison

in the idea of centralization, because it is very inconvenient to send the bills to Baltimore and send them back to Brooklyn and have them approved by the committee, and the checks sent from Brooklyn. I think it should be all under one head. I thoroughly agree with that, because it is simply having a position without anything to do for the treasurer to be in one city with the rest of the officers, and the business conducted in another. I will say for myself that I agree with the report to that extent and hope it will be carried.

A motion that the report of the committee be re-committed with instructions to report at some later session of this convention was carried

The PRESIDENT—having resumed the chair—I desire to add Mr. Duncan to that committee on by-laws. Mr Duncan, will you serve with the committee on by-laws?

Mr. DUNCAN: I will give them the benefit of my assistance.

Mr. SMITH, of the Allegheny County Light Co.: I would like to make an explanation. My object in speaking of the oil men was not to exclude them from the association; but I think, as I understand it—I may be wrong, as I am a newcomer here—that this association is especially for the benefit of those who put their money into electric light companies and that the great object of this association was to enable them to swap experiences and so on, and while in that case, although it is a very great advantage to have oil men and every one of that kind present, it seems to me there is a little danger of being outvoted on our own ground some day. It seems to me there might be some arrangement made by which we could have full members with voting power and others who have the rights and benefits of full members with the one exception of the voting power.

Mr. Garratt presented the report of the

COMMITTEE ON WIRE GAUGE.

A year ago in Detroit, a committee was appointed to consider the matter of wire gauge, which at that time was in an almost hopeless condition. After six months of constant correspondence with the largest users and makers of wire in this country and abroad and the leading scientists in the specialty of electricity, I reported at Philadelphia that this association do two things: First, that it vote that the British standard gauge be no longer the recognized gauge of this association, and, secondly, that the metric system be made the basis of measuring wire. Both of those motions—or they were incorporated in one motion, one report—were accepted. The honor conferred upon me in accepting my report was not less than the honor I received in being again placed at the head of the committee to elaborate this subject. The committee was considerably increased by the addition of some valuable members. During the six months we have taken the subject of measuring wire in simple diameter in the tenth of a millimeter and have elaborated it into a mathematical table. [This table will be found on page 89.] This table is not of necessity a gauge, although the first column to the left represents a series of even numbers—integral numbers, which agree with the tenths of millimeters which appear in the next column, or column 2. The object of doing that is this: In sending telegraphic messages I find it is almost impossible to make a telegraph operator use a decimal point. It is almost impossible also in hasty writing to get the decimal point in the right place. For common purposes, in speaking of wires in ordinary business parlance, a simple number is more convenient than a number with a decimal point, for this reason a column of figures is here placed with simply that decimal point removed. That, however, is not the gauge, if there is any gauge. The gauge, if there be one, is the simple measuring of wires in diameter in tenths of a millimeter. That appears in column 2. As we have in this country a unit which is much more familiar—the inch—it seemed wise to this committee to convert those diameters into inches for the purpose of referring to tables which are already constructed, and with which many electricians are thoroughly familiar. For that reason column number 2 was multiplied by a constant which represents tenths of millemeters in the denomination of inches. An electrician looks upon a wire not as wire as we ordinarily express it, but as a cylinder, and the properties of wires are based on the properties of cylinders. There are three properties of wires which enter into the work which we have to do: the tensile strength of the wire—that I shall not touch upon; it is a subject by itself and does not directly interest us; the static capacity of wires—that I shall not touch upon; the third property is the conductivity, and it is necessary for us to know the ratios of conductivity to weight, to size in diameter and to length of conductor. The first thing we want to know about a cylinder to determine its physical properties is its sectional area. In this particular table, to insure almost absolute accuracy, the mathematical work was done independently by two members of the committee; P. Keilholtz of Baltimore independently calculated tables 4 and 5 which you see here. Herbert H. Eustis calculated the same tables. They were both submitted to me; I compared them and found some differences. Where differences occurred, I independently made two calculations upon different days, and if those two calculations agreed I submitted them to the other gentlemen and the alteration was made in their calculation. Virtually then these columns 4 and 5 have been independently calculated by three persons. The likelihood of error has been reduced to a minimum by not calculating by ordinary arithmetic but by calculating in logarithms and the logafithm was used that is used in fine astronomical calculations—the seventh place logarithm compiled by Vega. I will say that carries the accuracy so far that even in calculations as to the solar system very slight errors are found. In that calculation comes in the property of the pi ratio. This section area was calculated by these two gentlemen from different formulas. Mr. Eustis calculated it from the square of the radius of the cylinder multiplied by this ratio. Mr. Keilholtz calculated it by the formula: The square of the diameter multiplied by 5 and divided by 4—two entirely independent calculations. Probably the tables here of area in square millimeters and square inches is about as correct as it is possible to make a table of figures. The calculation into the square inch, of course, was an independent calculation, bringing in the ratio which we already have between the inch and the square millimeter.

Before I go on to the other details I will say here why we put this question of sectional area so conspicuously on this table and so near the beginning The properties of conductivity of wire are directly proportional to the sectional area. I wish to refer one moment back. The pi ratio, 3.14159, is one which has never been written out. There is another number after the 9 and another after that. A distinguished French mathematician has carried that to 250 places of decimals, and there are others beyond that.

These tables of area are based upon that. The conductivities of wire are proportional to sectional area. They are, however, proportional to another property of cylinders which is entirely independent of the pi ratio and which is extremely simple in practical use. The conductivities of wires are directly proportional to the squares of their diameters. You will find away over here in column 16, squares of diameters. Wires have to be used by a great many men who are too hurried in life to familiarize themselves with mathematics and with electrical formulæ and who want to quickly get at what wires may be expected to do. From this simple table, number 16, by simple arithmetic, you arrive at almost any physicial or electrical property of the cylinder, or of the wire which is a cylinder. For instance, if I have a small wire, or if I have twenty small wires, and I wanted to have a large wire of the same conductivity I would simply have to take that square of diameter multiplied by thirty and look in the table and find the nearest corresponding numbers in this column number 16, and I would have the wire which would give the same conductivity. In problems involved in the work which linemen are obliged to do, who do not care to go into these matters at all, they have in such a table necessary data for determining nearly everything which they would be required to know.

I do not think I will go into determining constantsl which is a long mathematical work, and I think it wil, be understood how these various other properties were determined. I will say, however, that they were figured independently by two members of the committee. The units were taken from Mattison's last determination—the British Association unit—multiplied by the constant which converts that resistance into the legal ohm.

Many gentlemen will take exception to the fact that this is calculated at zero centigrade. This convention, if it sends out this circular, has got to commit itself toward the scientific world as having done a thing which no trade body in the United States has heretofore done. It is a scientific matter. It will be studied. These calculations will be gone over by scientists and mathematicians. Zero centigrade is now recognized the world over as the unit of temperature. There is no probability in the *immediate* future of its being changed at all. I have corresponded with leading professional electricians in this country and, without a single exception, they replied to me—"by all means determine your gauge on zero." Every electrician is familiar with the simple constant which is 21; by multiplying the zero centigrade, which is 32° Fahrenheit, by the number of degrees which it will differ from what we want, if you want to convert to 75° Fahrenheit, and multiply it by the constant, you will get the resistance of it in 75° Fahrenheit and you can do it at any other temperature at which you see fit to do it. But the zero centigade is that on which all scientific work is based when the question of temperature is involved.

The question of making these determinations of resistance, etc., on commercial copper, or on pure copper, the committee found it utterly impossible to determine what commercial copper was; hence, this table has been calculated upon the basis of chemically pure copper. If manufacturers adopt and use this it will be very easy for them to append a constant at the bottom of their table, which they can multiply into any one of these properties and convert the weight, the resistance, etc., directly into the degree of purity which they claim to put out commercially, and in an association we have got to have a thing which can be used as a standard all over the country, and for that reason chemically pure copper was taken.

There are two other tables which may not be of much interest, but which this committee has seen fit to tabulate, to enable electricians generally to make calculations of this gauge in fine electrical work, that is, a table of logarithms of area. We have appended seven place logarithms which have been calculated by three members of the committee—a logarithm of the square millemeter and a logarithm of the square inch of independent size of wire. That, of course, is not a commercial figure; I don't know that it will ever appear in a trade statement; but it is valuable for us to use and put out.

Last of all, and to get our minds familiar with an unfamiliar thing—and here I must say that of course it will be impossible to take up any new thing, no matter what its value may be, without putting ourselves to considerable worry—no man here could take up this metric gauge and work at it on five minutes' notice. He would not, however, work at it five minutes without discovering that he was using much fewer figures than would otherwise be necessary.

Tables 17 and 18 are the nearest corresponding with the Birmingham and Brown & Sharpe gauge. The Brown & Sharpe gauge I have taken from a manuscript copy sent to a member of this committee by Messrs. Brown & Sharpe, and I will say here that the wire drawers who publish Brown & Sharpe tables—very few of them—agree as to the actual size of Brown & Sharpe numbers. I examined one table in which, out of forty, numbers of Brown & Sharpe, twenty-eight were wrong, and that was from one of the best wire makers in this country—that is, they did not agree with Brown & Sharpe's own statement in regard to their particular gauge.

In regard to the Birmingham gauge, I will say there are fourteen independent Birmingham gauges in use at the present time. I have taken Mr. Gordon's figures in regard to the size of the Birmingham gauge for the purpose of comparing it with the metric. Mr. Gordon has spent a great deal of time upon the question of the physical and electrical qualities of wires. Among other things, he has compiled the largest tables on the properties of wires which has ever been compiled, expressed in the old ohm. I have taken his sizes of Birmingham to compare with the gauge.

I will not further bother you with these figures. Of course this committee has been very glad to do this work. All of the work other than the first five columns has been calculated by Mr. Eustis and myself. It has occupied every evening for three or four weeks until past midnight most of the time. We have put our best work and energy into this. We have based it on the best information that we could get inside and outside of this association and we have not failed to consult with anyone from whom we could get assistance. We have corresponded with the Smithsonian Institute at Washington, although they were unable, for want of apparatus, to give us any direct aid, they gave us their most hearty assurance that the deliberations of this assembly should receive proper recognition by the government of the United States, and if in their opinion, it was wise it would be adopted as the governmental measure of wire of the United States. I will say here that by act of congress the metric system is already the legal system of measuring of the United States government. It is used in many of the departments. Every scientist and every chemist works in it and it is simply a question of time, no matter whether we adopt this particular gauge or whether we discard it as useless—it is simply a question of time when the properties of everything that can be measured will be determined by the metric system. We have this now in this form. It is useless for any body of men to attempt to legislate what other men shall do. It is useless for a body of men to attempt to legislate what they shall themselves do. If this association should vote to adopt and use any other gauge than the metric gauge they never would be able to enforce it among their members unless those members found it for their advantage so to do. Personally, I do not anticipate that everybody is going to lay aside thousandths of an inch, the Brown & Sharpe gauge and the Birmingham gauge, and immediately take this up. I know, however, it is only a question of time when some such system of measuring will be used that will do away with all arbitrary numbers which in themselves convey no idea as to the quantity which you are expressing.

The question of bringing this commercially before this country is a grave one, and one to which I have not given the attention that I have given to the mathematical properties of the gauge. Of course, I have corresponded with all of the wire makers in regard to it, and at the last convention I read a voluminous correspondence from them, the majority approving of this and hoping that it would be carried out.

I propose this afternoon to have this table electrotyped. It will then be the property of the association in electrotype. It can then be cut up and such portions of it furnished to manufacturers as is thought fit. This gauge goes from the tenth of one millimeter to ten millimeters, which means from about a 38 wire to a number 00 or number 000 wire, in the proportions of the gauge which gives a much finer division than either of the others; in other portions it does not give near as fine. In the gauge which would be used in incandescent wiring, it gives much finer properties; for example, in number 12, there are five wires in this gauge instead of the dimension of number 12 wire, and electricians are getting to work finer and finer on the properties of their wires all the time. It is a tendency of the times to do so. As you go up into the larger wires it becomes very marked. In the larger portions of this gauge there are seven, eight, or nine numbers instead of the single number of Brown & Sharpe or the Birmingham gauge. I received a number of letters from well meaning persons calling attention to the fact that in a small portion of this gauge there is too great a variation between the numbers. That is very true; but nobody can tell just what size of wire anybody wants in these small sizes. To tabulate it would be to make a book as big as the dictionary almost; but from the figures given, any electrician can calculate the electrical and physical properties of any wire varying in hundredths of a millimeter. All of the data here is necessary for making such computations. I presume in those fine wires, if this system is adopted, you will find in the course of a short time that manufacturers will be publishing odd numbers; instead of number 2 gauge it might be 2.23, which might meet the particular requirements of somebody. Those first ten numbers will probably undergo considerable alteration. This will be the basis for determining those physical and electrical properties. Take it in the use of expensive wires—in platinum, for example; no man drawing expensive wires can afford to adhere to any particular gauge, because the requirements are so nice in regard to it; but from these data you have here, there is no difficulty in any one determining just what the resistance will be, or the size shall be, or the weight of any wire he wants determined in terms of a hundredth of a millemeter, which is about three times as small a difference as you will find in the thousandth of an inch.

I don't know that I have anything more to say. I have made myself extremely disagreeable to a great many people by making them work so much. I do not suppose there is a man on this committee who does not regret he was a member of it. I have troubled a great many people in regard to it. I called in the best expert testimony which I have been able to get in this country. I have worked the members of the committee night and day. I have put the matter in type. I bring the matter to the association. What will you do with it, gentlemen? [Applause.]

Mr Eustis: In order to give the association some little idea of the work that has been undertaken by the committee in tabulating this gauge I would mention that on a rough estimate of the number of figures necessary to calculate it comes out in the neighborhood of 30,000—probably rather more than less; that is, for each separate calculation Now, as the whole thing has been done three times it would make a nice little figure, very close toward a round 90,000.

Mr. Mailloux: I see a few friends of mine beginning to smile as I got up to say something on the wire gauge question, and probably what makes them smile is the remarkable slowness with which we have been arriving at any sort of conclusion relative to any wire gauge. The committee of the American Institute of Electrical Engineers has had the subject of wire gauge under consideration for a long time—it must be two or three years. There has been more or less interest taken in it by the members of the committee, and efforts to arrive at the determination on what is proper and right in wire gauge. I was very much interested, as a member of another committee, of the report made by Mr. Garratt, and I think that we should appreciate the care, the precision and the assiduity with which that committee has carried on its work. But at the same time I feel that I must emphasize a point which he himself has alluded to. I am brought to this by remembering that while a gauge may be particularly suited to the requirements of one individual or set of individuals, yet it is of the utmost importance that a gauge, in order to become universal, should have the elements of usefulness to all parties who are using gauges. I notice that between the sizes corresponding to No. 38 of Brown & Sharp, gauge and No. 32 he has only one number; there is only a difference of a tenth of a millimeter. Now, those who are in the telegraph business, and the telephone business and many other cognate industries, would see at once a very grave objection. It is true, as Mr. Garratt proposes, that we may have several sizes—smaller sizes in tenths of a tenth of a millimeter; but if we begin to introduce the subdivison of the scale it seems to me that we might just as well have no scale at all and revert to the principle of determining the diameter by the thickness in the first place, irrespective of any number or of any gauge for that matter. As you all know, it is a common practice in this country, and there seems to be a large preponderance of sentiment in favor of determining the size of wire by thousandths of an inch. The difference in the use of systems of measurement is one which has full weight, of course. At the same time we must not forget that in this country we are, so to speak, married to the old system of gauge and that there is only a very small proportion of the people who really understand the system or could use it intelligently; and therefore it looks to me that while the system is very well adapted indeed to the requirements of the electric light industry, insomuch as it affords a long range of sizes differing from each other by very much smaller differences than the gauge at present in use, yet, as we get to the other end of the scale it is not so far deficient as it was advantageous at the former end. If wire makers throughout the country were to adopt this system of gauge, and draw their wires in accordance therewith, then if a telegrapher or telephonist wanted to rewind a magnet that was 38 and wanted the next size larger he would have to use what would correspond to No. 32, and I find that the resistance per given length varies in the ratio of four; whereas by the present system we have a ratio which varies by less than only a little over 90 per cent.

After due consideration of all these points, our committee, which comprises in its body a celebrated engineer, a man who is connected with the United States army in the engineering corps, a very skillful mathematician, has come to the conclusion that no system of gauge in which the sizes are defined by equal increments of diameter can ever hope to meet the requirements of the general body of electrical industry, and if we look into the matter closely, we shall find that the gauges at present in use have after all a great deal of convenience, and that the gauge which would be based on the same principle would at least be entitled to some consideration before we vote to adopt definitely, and inflict upon the community one more of the numerous wire gauges. I say inflict, not because I wish to disparage the very fine work that has been done by our committee, but because, to add another official gauge to the number already existing would be to increase the perplexity with which we are now so greatly troubled in trying to make calculations regarding wire.

The basis, I think, of a proper gauge would be an asymptotic one—a gauge in which the sizes of wire vary with the resistance or the sectional area as a function, as a variable quantity, so that the ratio would be represented by a third, which is hyperbolical, somewhat nearly like the third of the present Brown & Sharpe gauge. I think it would be proper to modify these gauges by introducing some intermediate sizes. In that case, as it will readily appear, it would be possible to represent all the numbers of gauges by formulæ, so that, knowing one gauge or the diameter of a gauge, an electrician or a mathematician could easily calculate all the others and derive all the properties belonging to the others, and if he were using formulæ he could introduce the formulæ itself and in that way arrive at the properties of all others by the usual method of elimination of quantities.

Mr. Garratt: Will the gentlemen kindly give an example in gauge calculation which an unintelligent man could make on the Brown & Sharpe gauge or the Birmingham gauge, which he could not make by measuring wire by the diameters or tenths of a millemeter? He made the statement that the metrical system was unfamiliar to the general run of people, and therefore they could not use it with the facility with which they could use the Brown & Sharpe gauge. Will he kindly give me such an example, or will he state one on the board himself.

Mr. Mailloux: I think I should state that you find in practice that the electricians, or the men that Mr. Garratt refers to, the linemen, would not go to the trouble of multiplying, because a great many of them could not multiply two quantities of two figures each.

Mr. Garratt: You said they could make the calculation more easily with Brown & Sharpe's gauge than they could with the metric system.

Mr. Mailloux: I did not intend to say so.

Mr. Garratt: Then I misunderstand you, sir, and you did not say it. There is one other thing. He said it would be good to have the gauge on the same principle now in use. Will he be kind enough to state the principle on which present gauges are made?

Mr. Mailloux: The Brown & Sharpe gauge is the only one which may be said to have any principle at all in it. The others are merely an arbitrary form of gauge which has come from long usage and custom with reference to convenience, and when I speak of the objections to a gauge, I do not refer to the electrical features of the gauge only, because I believe that a gauge which can have any hope of being universal must be applicable to other requirements besides those of electricians. It is a custom in measuring sheets of metal and various other things in commerce, to measure by sizes like that, and it is doubtful in my mind if a system of that kind could be made applicable to those uses. Now the basis of the Brown & Sharpe gauge can be represented by drawing a triangle having a certain definite length and a certain base.

Mr. Garratt: Shall I state them for you? Will you please give them to me?

Mr. Mailloux: I do not know the figures at present. I know it can be represented by a curve which is more or less accurate. The trouble with the Brown & Sharpe gauge is that the ratios are not uniform, but they could be made so, and I think it would be possible to construct a gauge having an asymptotic curve as a basis which would be thoroughly scientific and satisfactory. I will say that I do not claim to understand the matter as fully as perhaps the gentleman himself does. He has gone into the matter more fully than I have. Other business has called me away from the study of these things, but I am fully convinced, nevertheless, that there is some consideration in favor of the other gauge, and that while this may be entirely satisfactory, and while it has great advantages on account of its metric basis, which I recognize, yet it cannot be denied that it does not answer the purposes of the other.

Mr. Garratt: I will say in regard to an asymptotic gauge that I corresponded as far as I could with every maker and user of wire in this country and abroad, and I found just one gentleman who advocated it, and he was a distinguished mathematician in the United States army—Captain Michaelis, of Troy. I corresponded with him on the subject and we could not come to any very good understanding. The asymptotic curve is the property of a tangent to a parabola of infinite distance. I did not find any other man in the United States—I have now found another—who advocates such a gauge. In regard to the Brown & Sharpe gauge, I do not think it was right for the gentleman to suggest to have a gauge on the same principle as the Brown & Sharpe, when that principle cannot be stated. Then in regard to just one more thing—he said a gauge can be used to measure metal. The properties of plane surfaces and of rectangular solid bodies follow simple mathematical laws. Will the gentleman kindly state some calculation in regard to sheet metal, its properties by weight, strength or anything of the kind which can be more readily calculated by the Brown & Sharpe gauge, or as easily calculated as it can be by the metric system.

Mr. Mailloux: That is not the question.

Mr. Garratt: Then I did not understand you, sir.

Mr. Mailloux: I think the question bears more on what people have been doing and on what we can make them do. I have no doubt it is easy enough to make a far more scientific gauge than people could use. We have the experience of this country in the rapidity with which it has adopted the metric gauge. I myself prefer the metric system to all others, and use it a great deal. I believe that in chemical work it is the only system by which satisfactory work can be done. But at the same time I note that it is not going into use with very great rapidity. I note on the other hand that it is being adopted in this country with great slowness and I doubt if the present generation will ever see the metric system in use in this country. What I have reference to is that as people are accustomed to gauging thickness by a certain letter we must not give them something which is so radically different that by its very radicalness we shall make people object to it.

Mr. Garratt: I have no reply to make to the gentleman opposite. I did not understand that the work of this committee was to consider the peculiarity of men's minds, in adopting that which they ought not to adopt. I was instructed six months ago that the report of the last committee was accepted. That report embodied the fact that we lay aside the British standard gauge and accept the metric measuring of wire. The work of this last six months has simply been to put that into a suitable mathematical shape, I understand that this is the report of this committee. I am not reporting on what I think people will do. I am reporting on the mathematical properties of the system of measuring which was adopted six months ago. As I say the United States government has adopted the metric system. As a professional chemist I agree with the gentleman in his statement that it is the only system you can use in chemistry. If he had calculated as much in connection with wire as I have, he would realize the extreme facility of making such calculations, and I have no reply to make to the question of people not adopting the metric system. I believe that every person familiar with it thinks that it will be adopted. The gentleman refers to the gauge; there is no gauge. I stated simply that from this table here we can calculate the properties of wire to the hundredth of a millimeter, which is three times as fine as the present system of work from a thousandth of an inch. The unit of a tenth of a millimeter seems peculiarly adapted to fine instruments of precision. The ten-thousandth of an inch is too fine, but the tenth of a millimeter seems to be just about the limit of ordinarily fine measuring apparatus like the micrometer screw which all electricians use in their calculations.

Dr. Moses: I feel a certain diffidence in speaking on this subject from the fact that my name appears on that committee as a member of it. I would say that though I am a member, all of the credit of the work is due in varying proportions to the other members on the committee. The honor of being put there by yourself was one that I appreciated, and when called upon to do my share of the work I was unfortunately sick, and since then I have been abroad and have not been able in the last few weeks to participate in the labors of the committee. I feel, too, as if I ought to give the meed of praise to my co-members on that committee for the very comprehensive and laborious work that they have accomplished. I also feel as if I should say, in view of the probable adoption of the report, that the metric system is one so well known and so generally used at present, that there is no necessity for us to advocate it as a standard. The government has done so already. Other governments, even the German government, opposed as they are to the French, have in a certain disguise adopted the metric system; they were forced to do it; so that we must, for the present, not consider the advisability of adopting the metric system because it forces itself upon us, and if we acknowledge it, we simply acknowledge the inevitable. But there is some weight in a remark made by Mr. Mailloux that I would like to call attention to, and Mr. Garratt sounded the key note of it when he said it was impossible to consider any standard of conductivity because it was something that varied with all of the commercial letters. It is a very important thing that there should be some standard always, but where you have the essential standard always varying, it is very difficult to fix it. But we have in the use of the units themselves the adoption of the metric system. We are employing them constantly for all the varying moods and tenses of the current, and why may we not adapt them to the uses of the consumers of wire, since ultimately what is to be determined is the resistance of the wire—since it is the resistance of the wire entirely independent of the material that has to be calculated by the electrician, it is of the utmost importance that we should be able to calculate the resistance rapidly. Now the resistance varies in any two specimens of wire. I take a wire; it measures such and such resistance; I twist it accidentally—it measures a different resistance. So we have to take something as we find it and determine what we have or what we want. Now I do not like to speak always in prophetic mood; but I think the day is not far distant when we shall have measures of resistance that will be as portable as a Brown & Sharpe wire gauge. I think that we will be able to take an ordinary lineman and give him this instrument and let him say such and such is the resistance measured on a dial, if you please, of such and such a length, measured for him and in the nature of the instrument itself constant and independent of his erroneous observations. He takes a certain resistance of a certain unit and if he can multiply—and he has probably been taught how to multiply though he has not very extended mathematical knowledge—he can multiply that and let the unit be an inch, a yard, a metre—anything you please—he simply multiplies it by the number of units that he wishes to multiply by, and he has his result accurately given. Now, I do not say that that machine is invented, but I say that it is possible to invent such a machine, and to make it most exact and very portable. It is immaterial to me whether my wire is iron, or gold, or silver, or whether it has a conductivity of A, B, C or D, as long as I get the greatest amount of conductivity for the least amount of resistance reciprocally for a given weight in hard cash. That is all I want to determine. When once that is determined, I give my order to Tom, Dick or Harry, and the man who gives me the most conductivity for the least money gets my order. It is quite immaterial to me whether it is number 38 or number 32. The little difference in the space that a wire occupies in a concealed fitting or in a pipe that brings it to a light or to a telephone does not impress me as being a matter of any very great importance. The insulation varies so in thickness; and as nearly all wires are insulated that are at present in use, it is immaterial for us to consider very absolutely what the exact diameter is. It is something entirely outside of the financial question. The question is, what is the resistance and what is the cost. Now those things will settle themselves the instant we have a little piece of apparatus by which we can take a unit of length and determine its resistance, and let that be done by the most uneducated person. I would, as I said in the beginning—if it is permitted to me as a member of the committee who waives any right to the praise—to extend the thanks of the convention to the laborious members of the committee who have sacrificed the midnight oil for the benefit of our association. [Applause.]

Mr. Mason: If I understand Mr. Garratt rightly, he states that one matter was decided at the last meeting of the association — namely, that the association adopt this system.

Mr. Garratt: Accepted it.

Mr. Mason: Accepted this system. I would like to ask the chair to inform us where it leaves us now. As I understood from Mr. Garratt the committee was continued to perform certain clerical work. If that is so, it is simply for us to determine whether or not they have done their work. If I understood him correctly, we are not called upon to discuss the question of this or that gauge, but of the quality of this work and whether we will accept these tables. Will the chair please decide that. I would say that I remember reading in our electrical newspapers that the report of the committee was adopted.

The President: [Reading from the minutes of the last convention.] Mr. Powers, of Troy, made a motion that the matter should be left in the hands of the committee for a further term and that the committee be increased to five, with instructions to report further at the next semi-annual convention; that in the meantime, the report of the committee be accepted and placed on file; that such suggestions as they made be carried out in regard to printing copies, so as to enable the members of this association to familiarize themselves with the new gauge in case it should be adopted at the next meeting. Now, is the case thoroughly understood? The fact is, the matter was referred back to the committee and it has come up in the shape of a report.

Mr. Mason: The mistake arose from the misuse of the word accept.

Mr. Lynch: I would like to suggest that Mr. Garratt add to his already very excellent report a column showing the safe current carrying capacity of the wires at different temperatures.

Mr. Steuart: I have heard what has been said for and against the report of this committee and I would, add my voice, to what Dr. Moses and others have stated, in commendation of the admirable work done by the committee. They have gone into the subject most laboriously and intelligently, and I think the least we can do, under the circumstances, is to adopt the report of the committee. They were appointed a year ago; they have gone through the subject as thoroughly and laboriously as possible; they have given us the benefit of the work done, and they have produced it here in a most intelligent and thorough way, and I would therefore move that the report of the committee be adopted.

Mr. Lynch: I second the motion.

Mr. Phelps: I would like to ask what the significance would be of adopting the report. Will the association be committed to promulgate this as a wire gauge and recommend its adoption as a wire gauge or not? Much has been said, but too much cannot be said of the value of this work.

The President: I will answer that question of yours first. If this report be adopted, then this association pledges itself, and its members pledge themselves, or each one pledges himself individually, to carry out the law laid down by this report. You may call it whatever you please, but this committee reports a method for measuring wire which we will adopt if we adopt the report.

Mr. Phelps: The key to what I was going to say is furnished by Mr. Garratt in his remarks a little while ago when he said, there is no gauge. It is an infinitely useful compilation. A useful system is here provided for ordering wires by diameter, and a great step in my judgment is taken and gained in using metric diameters instead of inch diameters. But I should hesitate myself to assist in promulgating a wire gauge. I think if we were to think the matter well over, in view of Mr. Garratt's remark that there is no gauge, unless you choose to call it so, but an almost infinitely useful aid to the manufacturer and orderer of wire, and if the association can promulgate this information in a way to make it useful to everybody having to make, buy or use wire and by so doing put a peg in towards the further use of the metric system, that, it seems to me, will be a useful thing to do; but do not let us call it a new wire gauge. We have got more wire gauges than we want. You see my idea, Mr. President. I would like to hear from Mr. Garratt.

Mr. Garratt: There is no wire gauge about it. If I understand the matter right the electric arc light men will use a definite number of wire, perhaps; the incandescent men will use a certain other definite number; the men who make hairpins will use another number. They will have those sizes and it doesn't make any difference whether you express them in tenths of a millimeter, in thousandths of an inch or any other measure you see fit. All that I advocate is, that we express the size of the wire we use in the metric system and not by an arbitrary number which means nothing.

Mr. Phelps: It is very gratifying to know that practice of ordering wire by diameter has been constantly growing of late years. It has been found a sort of necessity by people who require wire of any accuracy. Part of the work has already been done. We are accustomed to ordering by diameter, but mostly use thousandths of an inch. This information will enable people to use a better unit of diameter, and that is the main function of it, and the information supplied here of the physical properties of wires based upon their diameters is something we have not had before, and as I said before, should prove infinitely useful.

Mr. Garratt: If you introduce this asymptotic curve, you are introducing the question of high mathematics again, you are plunging us again into a new gauge, you are plunging us into something that is purely arbitrary. It will be a laborous thing for thousands of people in the United States. We measure ground by feet and rods; we measure length by thousand feet; why not express our wires by diameters and by the metric system?

The President: I suggest to the association that you make this the special order for a fixed hour on Thursday and that will give the gentlemen an opportunity of studying the details and coming intelligently up to the work again.

The suggestion was adopted.

The President: In the absence of Mr. Slattery, who was to have read a paper on "Electrical Distribution by means of Alternating Currents," we will take up the partial report made by the committee on "Insulation and Construction of Plant."

Mr. Robertson: I would like just a word here in reference to that report as a member of that committee. I have read a rough draft of the partial report the committee has made, and not being able to indorse the report before it is presented to the convention I would say that the committee as a whole have resigned from the work, and as I could not indorse what they said I would not resign with them. Finding myself in a small minority, not even a fighting minority, I would ask you to accept my resignation. I received a rough draft of the partial report late on Monday and therefore could only study through it hastily, and supposing they were going to make a report, until yesterday, I was totally unprepared to make any report whatever. I beg that you will accept my resignation and let me out of the scrape.

A motion to accept Mr. Robertson's resignation was then carried.

The President: Before placing this paper in the hands of the secretary to be read, I beg to say that on a date which I am unable to find in the correspondence, this committee — either all six, or one of its members, perhaps more, wrote to me asking that the National Electric Light Association furnish them with a fund of $1,000 to carry on their investigations, guaranteeing the cost of repair to any apparatus that might be damaged in the course of their investigations — apparatus which was to be supplied to them from the University of Pennsylvania; also that an assistant be furnished at $3 a day. I laid that correspondence before the executive committee which met in Boston on June 9th. The committee found only one course open to them. The funds of this association are applied to its running expenses, with which you are all familiar. There was no such sum on hand to be turned over to the committee. Nothing more was heard from the committee until this paper, with quite a column of printed matter, was sent in yesterday or the day before to the National Electric Light Association. Now this paper is signed by Edward J. Houston, chairman, William D. Marks, Carl Hering and M. M. Garver, and is not signed by Mr. Robertson, and the reason he gave for his resignation, independent of this paper, was that he could not subscribe to the subject matter contained in this report.

The secretary read the

REPORT OF THE COMMITTEE ON PROPER INSULATION OF WIRES AND PROPER INSTALLATION AND CONSTRUCTION OF PLANTS.

The committee appointed by your honorable body hereby respectfully submit the following report: The rapid growth of the electric lighting interests during the last decade, the large investments already made in such interests, together with the still greater growth that is probable in the near future, have strongly impressed your committee with the important nature of the work entrusted to them. Your committee fully recognized the fact that any report to an association that represents the leading electric interests of the country would naturally be expected to be of a thorough character; they therefore determined, as far as lay in their power, to spare no labor in the performance of their work.

The duties charged on the committee naturally divide themselves into two general classes, viz.:

I. The proper insulation of the wires or leading conductors.

II. The proper installation and construction of the plant as far as relates to the insulation and protection of the machines, lamps, conductors and accessories, and to the safety of consumers' attendants and buildings.

The first branch necessitates an exhaustive and carefully planned series of practical tests as to the insulation of the leading wires; the second, the preparation of a code of rules based on actual experience for the general installation of the plans, both so far as concerns the insulation thereof, and for its protection, as well as that of the consumers, attendants and buildings; or, in other words, to provide for such an installation of the plant as will best insure the protection of life and property.

Referring to the first branch of its work, your committee appreciate the fact that a mere theoretical discussion of the subject would prove of but little value to an association composed of men practically engaged in electric lighting.

They are aware that considerable valuable data have already been accumulated concerning the high insulation required for telegraphic cables, especially submarine. They are also aware that laboratory tests have been made of ordinary electric wires. These data, however, either refer to conductors not included in the scope of your committee's investigations, or, though referring to electric light conductors, have been made under conditions that would render them but of little practical value in this connection.

Your committee therefore planned to make a careful series of practical tests under conditions as nearly as possible similar to those to which the conductors are actually subjected in existing installations.

The committee determined to limit their investigations chiefly to the leads that are ordinarily used in arc and incandescent lighting, subjecting them during such tests, as nearly as possible, to the various disturbing or other conditions that are met with in actual practice. They hoped by these means not only to obtain data by which the relative commercial efficiency of the different wires in the market could be determined, but also possibly to lead to the determination of the best conditions to be observed in the manufacture of insulated wire, in order to insure the production of the most serviceable material.

Tests, such as those contemplated, and of necessity required by the character of the work, not only called for excessive labors on a part of the committee, but also for the use of specially designed apparatus. Although the committee had the use of the well equipped electrical laboratory of the University of Pennsylvania, kindly placed at their disposal by Prof. Marks, one of the committee, and the use of valuable apparatus belonging to other members of the committee, additional apparatus was required, which, if specially designed, must be purchased, or, if of existing types, must be borrowed. Then, too, the services of an assistant were required to start and look after the fire for the steam engine, clean out the boiler, run circuits, and do such other work as the committee could not be expected to do.

In order to obtain for these tests currents similar to those used in actual practice, various dynamo electric machines would necessarily have to be borrowed. In view of these facts, the committee deemed it but fair to request the association to guarantee a sum sufficient to meet actual expenditures, and further to assume responsibilities for apparatus loaned to the committee, feeling sure that the association could hardly expect the committee to assume such expense in carrying out work of the character entrusted to them. This request, the committee were informed by your representatives, could not be entertained. The committee are therefore forced to resign.

Desiring, however, to give to the association such incomplete parts of their work as represented the results of their labors up to this time, they beg leave to submit the following incomplete report:

1st. On the preliminary code proposed for the tests on insulation of the conductors, etc.

2d. On an incomplete draught of a preparatory code of rules and regulations for the installation of an electric plant intended to serve as a basis of experiment by the committee, and to be sent in printed form to the various electric companies and insurance interests for comment and criticism, before finally being submitted to the association.

As regards the preliminary code of tests, however, your committee wish it to be distinctly understood that they recognize the fact that preliminary tests on such code would in all probability show the code to be impracticable in certain portions, or at least to need modifications or additions

In the preparation of the following preliminary code the committee bore in mind that leads possessing the requisite durability and efficiency for electric work, should possess as far as possible, the following requisites, viz: 1st. High insulation. 2d. Impermeability to moisture. 3d. Incombustibility. In this view we submit the following preliminary code for tests, subject to the changes, modifications or extensions already referred to.

PRELIMINARY CODE.

(1) *Leakage Tests.* (*Arc Wires.*) A definite length of insulated arc light wire to be immersed all but the ends in water. The water is connected to one pole, and the copper to the other pole of a machine giving 3,000 volts, which is assumed to be the highest electromotive force ever used in practice. The leakage from the copper through the insulation to be continuously measured by a suitable Ampere meter, the measurements beginning immediately on the immersion of the wires, and the tests to be stopped when the leakage reaches a certain definite amount. The greater or less rapidity of increase of leakage may then be assumed to indicate the less or greater value of the insulation.

Incandescent Wires. Incandescent wires will be subjected to similar tests, differing only in the voltage to which the insulation is to be subjected which will be in the neighborhood of from 100 to 150 volts, since, as it is known, at a voltage of, say, 60 volts, moisture does not seriously interfere with ordinary underwriters' wire, while a somewhat higher voltage will set fire to wood through underwriters' insulation.

(2) *Absorption Tests.* Coils of wire of definite length are immersed in water, and their ability to resist penetration, or absorption thereof, will be measured by the increase in weight after equal duration of immersion.

(3) *Frost Tests.* The ability of the insulation to resist the disintegrating effects of frost, on the alternate freezing and melting of the absorbed moisture, will be tested by the similar effects produced by the alternate absorption and crystallization of a solution of some chemically inert salt, such as magnesium sulphate. After the wires have been subjected to the frost tests (3), the leakage tests (1), and the absorption tests (2) will be repeated.

(4) *Flexibility of Insulation.* A definite length of wire will be wound around a small cylindrical rod, say one inch in diameter, after which the leakage and absorption tests (1) and (2) will again be reported.

(5) *Abrasion Tests.* A definite length of wire will be bent in the form of an inverted U, having a given radius of curvature and will be hung over a wheel, such for instance as a gear wheel having polished teeth with rounded edges, and heavy weights will be attached to the two ends of the wire. The wheel will then be turned and the number of turns noted before electrical contact is made between the copper of the wire and the metal wheel.

(6) *Adhesion of the Insulation.* A definite length of wire is bared of its insulation at one extremity, and the bared end passed through a closely fitting hole in a die plate. A measured pull is then exerted on the bare end of the wire until a definite length of the insulation is stripped of the wire.

(7) *Refractory Qualities of the Insulation.* The current will be passed through given specimens of the wire and increased in quantity until the insulation is destroyed and the nature of the destruction noted, whether in the form of flame, charring, etc., etc.

(8) *Ignition Tests.* The ability of the insulation to

resist ignition by some external source of heat similarly applied to all the wires, and the rapidity with which the flame started at one point travels along the wire, will be carefully noted.

Besides the foregoing tests as to the quality of the insulation, the committee also proposed testing the conductivity and flexibility of the copper, as follows, viz.:

(9) *Conductivity Tests.* The conductivity of the copper will be measured assuming the wire to have the diameter claimed by the makers.

(10) *Flexibility Tests.*—A given piece of wire will be bent repeatedly backwards and forwards around a templet, curved to a quadrant of say one inch radius, the number of bendings required to break it being noted. In order to procure wire of the same quality as that commercially sold in the open market, it was proposed to purchase the specimens tested in the open market direct from the makers

The second duty charged on the committee was, as already stated, the preparation of a code of rules, based on actual experience, for the general installation of plants, both as far as concerns the insulation thereof, and for the protection of the plant, consumers, attendants and buildings. The importance of a code of rules of this character, relating as it does to the better protection of life and property, is generally recognized, both by electric lighting and insurance interests. It is to the true interests of the electric lighting companies to assure the public that not only can they through electricity furnish a steady, reliable and cheap illuminant, but that such illuminant, if intelligently employed under certain well considered regulations, is as safe, indeed, far safer, than any other artificial illuminant. While, therefore, electric lighting companies should not hesitate at the adoption of the most stringent regulations that experience has found necessary for the protection of either life or property, it is of course advisable that all arbitrary and meaningless regulations should be carefully considered before their adoption by the National Electric Light Association. It has therefore been the aim of your committee to obtain a code acceptable alike to electric lighting and insurance interests.

As preparatory to the framing of such a code of rules, the committee planned the following work, viz.:

1st. The preparation of a compilation of existing rules.

2d. Obtaining the opinions of the principal electric light and insurance companies, as to the practicability of existing rules and requesting suggestions of such changes or additions, if any, their experience might suggest.

3d. Conducting a series of experiments so as to determine, as far as practicable, reliable data on which a code could be deduced, affording the widest latitude to electric light and power companies consistent with absolute safety to life and property.

4th. From the above to deduce a code to be regarded as a preliminary code.

5th. To have printed copies of such preliminary code sent to all electric light and insurance companies for comment and criticism.

6th. Finally to prepare a code to be submitted to the National Electric Light Association of America.

In carrying out this branch of its work, the committee has addressed letters to electric lighting and insurance interests, asking for copies of existing rules, etc. To a certain extent these letters have been answered, and copies of existing rules and regulations (though by no means complete), have been received, and the committee had commenced a compilation of the same. In the desire of aiding the association they hereby respectfully submit such incomplete collection and compilation.

Being forced to abandon their work by reason of the failure of the association to make the appropriation necessary to carry out the same, the committee hereby submit the above incomplete report, and respectfully offer their resignations as members of the committee and request that they be relieved from any further work in the matter. Signed EDWIN J. HOUSTON, Chairman, WM. D. MARKS, CARL HERING, M. M. GARVER.

Mr. KINSMAN: Is there any item there in regard to the time test—that is the cracking of the wire.

The PRESIDENT: No, sir.

Mr. KINSMAN: I move that that be introduced. I have some experience on wires that tested well before we put them in, but did not stand the pressure of time.

The PRESIDENT: There were no exhaustive tests made by this committee at all. They had completed their work to a point where they required financial aid to carry it on. They applied to the association for that aid. The association was unable to give it, and the committee present this report and resign. It is put in plain and unmistakable language so that you may know if you want any further work done you will have to pay for it. The paper is open for discussion or for whatever disposition you choose to make of it.

Mr EUSTIS: We have had some little experience in wire. A good many years ago, when I was with the Bell Telephone Company, I decided to test a wire there and made out a report of the wire. It tested splendidly after soaking for about two weeks. I made out my report, but fortunately it was not handed in. I put the wire up on the shelf and glancing at it I saw that the insulation was cracked from one end to the other, showing that while the wire might test perfectly well while still wet, after it had dried out a trifle, it was absolutely "no good." For practical working, that, of course, is a strong point—that a wire should test and not become oxidized and cracked. There is also the other question which I think should be brought up there, and that is the question of mechanical injury to the covering—abrasion. We all know wires are strung where they are liable to swing against awnings, the fronts of houses, trees and so forth. That I think is also a question which should be brought up here.

Mr. MASON: I suppose we must decide this question now whether money shall be appropriated for such an object. I do not suppose, Mr. President, that another committee could be found who would undertake the work which this committee has declined to pursue and undertake it at their own expense. I wish I could hope that I was wrong on that point; but I do not believe that any committee will undertake an expense of a thousand or two thousand dollars and pay it out of their own pockets. At any rate, although I am very anxious indeed, from my own point of view, that the work which was given to this committee shall be done, I do not feel like asking any committee to bear that expense. It seems to me as if the necessary expense of making tests, the results of which would be so valuable to the members of this association—it seems to me that we ought not to shrink from incurring that expense. I want to test this thing, and so to bring it before you, I move that the resignations of this committee be accepted and that their partial report be also accepted, proposing to move the appointment of a committee and the appropriation of a suitable amount of money to enable them to carry out such plans as they shall deem wise for the determination of the end sought by the committee whose resignation is now offered. I move the acceptance of the partial report and of the resignation of the members of the committee whose names are thereto appended.

The motion was seconded.

Mr. DECAMP: I understood from that report as well as from Professor Houston personally, that that is not made in the nature of a report—that they could not report for lack of funds to carry out their investigations. What they have said there is in the nature of suggestion.

Mr. MASON: They use the term partial report, do they not, Mr. President?

The PRESIDENT: Yes.

Mr. DECAMP: I do not think that the committee want to be responsible for that report. The question arose in my mind what disposition we ought to make of it.

Mr. LEGGETT: It suggests itself to me, the same as to Mr. DeCamp, that inasmuch as the committee admits this to be far short of a report, that it would be better to accept their resignation in view of the circumstances which they have set forth and to lay this report on the table.

The motion was seconded

The PRESIDENT: Do you offer that as a substitute for Mr. Mason's motion?

Mr. LEGGETT: Yes, sir.

Mr. MASON: I understand you to say, Mr. President, that I am right in my memory—that the gentlemen who sent us this communication style it a partial report. I therefore made my motion that their partial report be accepted.

The PRESIDENT: They style it here: "Report of the committee of the National Electric Light Association on 'The Proper Insulation of Wires and the Proper Installation of Plant;'" and they say "The committee appointed by your honorable body respectfully submit the following report."

Mr. MASON: And afterwards they speak of it as a partial report. If not, I should wish to modify my motion.

The PRESIDENT: You had better modify your motion; this a report.

Mr. MASON: It would not be in order for me to make that amendment in view of the one before you. I will withdraw the word "partial" with the consent of the body.

Mr. LEGGETT: Then I renew the motion that this report, which is admitted incomplete, and for which the committee would not probably want to make themselves responsible, or the convention desire to accept as an expression of its will, be laid on the table.

This motion was put and carried.

The PRESIDENT: The Boston Electric Club have extended an invitation to the members of this association to attend a banquet to be given on Wednesday night at the Point of Pines and they request that the members of the Association call at Room number 14 and give a written acceptance of this invitation.

The convention adjourned until 2:30 P. M.

TUESDAY AFTERNOON'S SESSION.

The PRESIDENT: The first business of the afternoon sesion is the report of the committee on Electrical Distribution by means of Alternating Currents.

Mr. SLATTERY: I regret to have to announce the absence of our very able chairman who had to report upon this important subject, secondary generators. In his absence, that duty devolves upon me, and I feel the onus of the obligation involved of doing justice to a subject which is fraught with a great many perplexities.

Mr. Slattery then read the

REPORT OF COMMITTEE ON ELECTRICAL DISTRIBUTION BY ALTERNATING CURRENTS.

One short year ago the commercial success of the branch of electric lighting in which induction coils are used was by some of our best authorities considered very problematical, but practical use of the induction system has not only succeeded in commercially converting high tension electricity to low tension for electric lighting purposes, but also high tension theoretical opponents by practical demonstration of facts. Upon the occasion of the last convention, the extensive use of the induction system received its first authoritative endorsement by our esteemed friend, Dr. Otto Moses. Although he was by some considered over enthusiastic in his statements, time has served to prove the correctness of his views and the realization of many of his anticipations. We will go back six months, and mentally what do we see in this business from here? A few experimental plants scattered about in various parts of the country, struggling for public recognition, and with the innumerable detail difficulties, which dog the footsteps of every new departure, difficulties the magnitude of which are usually in proportion to our ignorance of their nature, and therefore more frequently than not unduly magnified. Now what have those difficulties been, and has the past six months' experience enabled the manufacturing companies engaged in this branch of business to eliminate them? We find there were three factors in the induction system that required all the ability of the electrical engineer to work out and place upon a proper footing, namely the dynamo machine, the induction coil and the disposition of the external circuit to take the best advantage of the use of the induction coil. Of course, there were alternating dynamos in existence, as were also induction coils before this lighting branch of business had acquired any prominence, but they were not such as would meet the new requirements.

We will first take the dynamo. It will be familiar to all of you that no matter how intimately acquainted you may be with the construction of dynamo machines, when you start in to build a new type your previous experience, however valuable it may be, does not enable you to foresee innumerable detail difficulties which will assuredly develop with practical use, and which take time to ascertain and remedy.

Well, so far as we have been able to learn, the weaknesses which developed in this apparatus were, first the liability of the current to jump across the coils in the event of the field being excited with the armature circuit open. This open circuit sometimes happened by a dead cross occurring some place in the mains, blowing the fuse at the dynamo, thus opening the circuit, and then the field being fully excited the armature would generate an exceedingly high electromotive force for an instant; the current under the circumstances would be very liable to jump across the coils of the armature and other hurtful effects to the machine would ensue; the remedy for that was inserting at every branch in the external circuit a junction fuse, and at various points along the mains and sub-mains section fuses to such an extent as to make an open main a remote contingency. It was also found that the armature heated excessively owing to the presence of the plaguey Foucault currents. It was found that this evil could be almost wholly suppressed by building the armature without iron and avoiding as much as possible the use of masses of metal in proximity with the armature coils. In this connection Siemen's early type of alternating dynamo slightly modified to meet the new requirements might read us a lesson.

It was a bold step when the alternating dynamos were constructed with iron cores, and those who make this class of machine for this high tension incandescent business might give us some interesting information. To my mind this iron core construction speaks of disagreeably high temperature. I do not say that they will not be able to present a rational theory why this evil may not be or has been greatly modified, but the fact existed in the past, and as far as we have been able to ascertain stands unrefuted at present. One thing, however, is pretty evident, that just now this type of machine appears to be finding a rather extensive use, evidencing that it must be doing good work. So much for the alternating current dynamo, a machine destined to play a most important part in the future electric lighting business, and in the light of the past experience no doubt should exist in the minds of anyone here that these dynamos in practical use are now almost, if not quite, as reliable as any other dynamo, while coupled with this is the important factor of a pretty close self-regulating property attainable in this system, without the necessity for any particular method of winding that property, following chiefly as the result of the use of the induction coils. It is satisfactory to know that during the probation of this system every accident of any importance which has occurred to the dynamos has been of a purely mechanical nature, and our mechanics have reduced them to a minimum.

No doubt the induction coils have been a source of considerable anxiety, not because there was any obstacle in the way of obtaining high electrical efficiency, this latter appears not to have been by any means a difficult problem to solve; the source of greatest trouble has been, as far as I can learn, that of insulation; in what form will the weakness appear has been a question often asked himself by a timid electrician, and as usual the most unlooked for troubles developed. At one time an unaccountable defect in the insulation of the secondary coil would occur, cutting out a number of convolutions, thereby causing annoyance by reducing the incandescence of the lamps in its circuit; the remedy was simple—increase the insulation of the wire and exercise still greater care. The same accident would still more frequently happen to the primary coil, the same remedy applied overcame it; sometimes a number of the layers of the primary coil would thus be suddenly cut out, resulting in the passage of a much heavier current than the fuse in the coil box had carrying capacity for; the fuse would then melt and possibly draw an arc that you had a great deal rather do without if you could; the remedy for that was, keep on insulating the primary coil layers from each other until the trouble ceased, and increase the distance between the ends of the primary fuse to such an extent that when the latter melted an arc, no matter how great its volume, would not be able to bridge over the distance, which, after all, was calculable because the E. M. F. was constant. Then, again, metallic contact would take place between the induction coil and the iron box in which it was mounted, and if that box happened to be placed anywhere near a ground, possibly unpleasant electrical experiences might be related in wet weather. It was again only a question of looking out for the insulation to reduce such defects to a minimum, well—the insulation appears to have been looked out for as the smooth and safe working of that branch of the business would now seem to testify, and today that part of the system can be made as reliable, simple and as easily disposed of as any other part of an incandescent system. Thus the two new and troublesome factors have gradually and surely been strengthened for their future work.

The next in the system, viz., that method of distribution which would enable you to utilize the induction coil to the best advantage, although apparently presenting the simplest problems at the outset, has required a great deal more thought than was anticipated. It was found that no particular rule, as in the case of low tension distribution, could be carried out, the methods of distribution varying with the condition of the district in which you had to distribute.

In some cases the wires were run out from the central station through the center of distribution and tapped at any point along the route where lights were required. This was the earliest and simplest form of distribution, and an-

swers perfectly well for comparatively small installations, it being desirable to keep the loss in the mains down to about two per cent. and perhaps about two to three per cent. in the induction coils, so that the incandescance of the lamps should not vary appreciably throughout the system. This arrangement of the circuit may be carried out in small and very scattered towns, where it has been found to answer admirably. In other cases, where the district is more densely populated and a large installation is required, the inductoriums are placed in the centers of distribution and used like so many stationary dynamos, the light tension primary current with comparatively small conductors feeding each of these centers, the secondary or distributing circuit being taken where lights are required. Still other methods of distribution are carried out, but what has been stated in this connection will serve to show that again the past year's familiarity with the business has given an opportunity to perceive and profit by many advantages the system offers.

One of the last, but by no means the least point that I shall touch upon, in this interesting subject, is the question of comparative cost of the main conductors required in installation of an induction, and low tension incandescent plant. Not at all unfrequently we shall find ourselves called upon to figure upon a plant like this. From the source of generation to the point of distribution is one mile and a half, making a three mile circuit; at the point of distribution, you are required to distribute some 400 sixteen candle power lamps at, say, five per cent. fall of potential, which appears to be about the limit allowed the induction system. The necessary conductors for this purpose, in the induction systems now in use, would be number 2 Brown & Sharpe, which will cost about $230. In the case of the low tension installations, upon the low tension system, you would require a conductor costing about $1,050. Should you be required to distribute throughout the whole of the length of the circuit, the wire, such as is used for ordinary arc lighting purposes, would be amply sufficient for the induction, and of course a proportional reduction may be made in the low tension.

Now, a great many exaggerated statements are made with regard to the dangerous shocks to be expected from this alternating current, and while I am not prepared to say that the physiological experience of a shock from a thousand volt dynamo is the most agreeable thing in the world, I am prepared to say that the shock is by no means as severe as that received from a continuous current dynamo of the same voltage. A few weeks ago a man showed me his hands which were horribly burned, he had received a shock from an eleven hundred volt dynamo, and he said, with a visible tremor in his arms, as if the recollection of that shock was still vividly impressed upon his mind, that he experienced the effect of that shock for more than a week afterwards A friend of mine was testing a 400 light 1050 volt alternating dynamo, fully loaded, only a few days ago, and going towards the machine his foot slipped and he fell quite close to it; in his confusion he quickly reached out his hands and unfortunately placed them directly upon the poles of the dynamo. He said from where he fell to the wall behind him was about fifteen feet and it seemed to him as if that dynamo was suddenly converted into an electrical gun, and he got shot across the room until the velocity of his movement was interfered with by the wall. There was scarcely the appearance of a burn on his hands, merely a pin's head matter, while the effect of the shock was felt by him only for a few hours. It might be said that the difference of the effect of the shock was owing to the difference in the temperament of the two men; that may be so, but I have received three pretty severe shocks from a 1000 volt alternating machine, and however much I may have felt inclined to dispense with the shaking up it gave me the experience has been of value to me—one cannot have everything.

One word more, in conclusion. The induction system has evidently come to stay, not because enthusiastic advocates think or say so, but because the expert public, the central station public, have practically endorsed it, because it more nearly than anything else meets their immediate and anticipates many of their future requirements. More especially is its advent doubly welcomed just now with this misconducted overhead conductor warfare pressing on every side, and which is every day acquiring seriousness in proportion to the increase of copper wire in the air, and I think that this system, with its comparatively small mass of conductors, will postpone for a considerable time the necessity of going underground with the electric light wires, until more extended experiments shall have given us the confidence in underground systems that experience in the past has materially shaken.

The PRESIDENT: Gentlemen, Mr. Slattery's paper is now before you for discussion.

Mr. SLATTERY: If I might make a suggestion, sir, we have our old friend Mr. Duncan present, who is fully charged with alternating effects this afternoon, and we shall be very pleased to receive a shock from him.

Mr. DUNCAN: I am not very well charged to-day. It has been a very fatiguing day for me. The atmosphere of this room is not such as represented by the mayor of Boston. In regard to the alternating current system, I have simply to say that there is no question about the practical and efficient working of that system. There have been some things which required a practical demonstration to bring them out, and there are some things about the system yet which are not fully solved, but which are being rapidly evolved. There is no question about the covering of a given space and the distribution of a large number of lights much more economically than there is in a direct system. Now, as to the question that comes up in regard to the difficulties suggested by Mr. Slattery, those are questions which are gradually working themselves out as he stated in his excellent paper. One of the difficulties which was first experienced, as he says, was the induction-box itself, but practical experience of four months in the use of that box has been such as to show that in every respect it is entirely efficient, entirely satisfactory, and that it can be determined and relied upon to be placed in any position to do its work effectually and efficiently.

In regard to the dynamo, he has gone through that part of it. There is some heat naturally generated from any dynamo. I do not know that I can say that we get any more heat from the alternating current dynamo than we do from the regular arc light dynamo; I do not think we get much less; I know we do not get a great deal more. In the heating of the parts in the original machines that were made there was considerable difficulty. Insulation has been provided from time to time, and at the present time I know of machines which have run successfully for three months to which nothing has ever been done. Some of these machines will average in a week's run 24 hours per day except Sunday, and they will be shut down on Sunday for about two hours. In regard to the efficiency of the system I am satisfied myself from my own knowledge and from the experience we have had with it that for a long distance lighting, for city lighting, for covering a straggling community where the lights will be necessarily very much scattered and where it is not a compact part of the city like most centers, that you can do it more efficiently and more economically with that system than you can with the direct.

Mr. SMITH, of the Allegheny County Light Co: I would say that I have had some experience with the alternating system in the same company with which Mr. Duncan is connected, and also with another company in Philadelphia where we started first with the direct system and changed it to the alternating. Some of the points on which Mr. Slattery has asked for information I may be able to give him some information about. We have found that where we are using the converter system its enormous flexibility enables you to apply almost any system you want. In one of our stations in Pittsburgh where we rent lights in a poor neighborhood, where the majority of places would demand three or four or five lamps, we found it cheaper to place the converters on the place, using either 50 volt or 100 volt lamps, as we pleased. In the other parts of the town, where we found buildings taking ten, fifteen or twenty lights, we found it better to take the high tension right into the building and place the converter into the cellar or the garret. In some cases, we have a mixture of the systems. For watchman's lights we have both the secondary main outside and the converters directly in the building. In very large buildings we carried the high pressure mains over the building, that is, through the building and tapped to our converters wherever convenient. In the case of hotels, we have a high pressure wire down to the center of the corridor and in the case of a large parlor being lighted, we would put a converter into that parlor. In the case of a row of bedrooms requiring twenty lights, we would put in a twenty light converter; without the slightest trouble we change buildings having three or four hundred lights from one system to the other without cutting off the lights for a moment, by cutting up the existing wires as they exist in the sections and tapping in the converters one after another as we need them. Whenever we wished to change a section we would substitute our 50 volt lamps for 100 volt lamps. When we had all the lamps changed in a building we would splice up where we had cut. In a building having 300 lamps we only put in converter capacity for 200, knowing that no more than 200 lights would be burned at one time.

As regards the danger of shocks I have had a little experience on both sides. I have had a full share of the arc light shock. I opened circuit on 1500 volts, which was sufficient for me. I have also taken a 1000 volts alternating, and there is no comparison between the shocks at all. If I may be allowed to give my own experience, I should say that the Thomson-Houston machine gives about the most tremendous blow I have ever felt. It is a peculiar dead stroke which you do not find in the Brush. But the alternating machine seems to throw you off instantly; you do not have time to take hold. We had a case in Philadelphia the other day which I think will be something for Mr. DeCamp to hear, as I believe he feared it was one of his men. We had been changing one of those buildings from direct to alternating, and while the building was still on the direct current one of our wire men went into the cellar and put an ordinary key socket on to the mains to give him light. After the building had been turned into alternating current one of these wires which had been used originally became a dead wire, and the lamp having been taken out of the socket, there was no current passing through the wire. One of our men went down stairs to make some changes and our foreman cautioned him particularly to look out for those alternating current wires, as one of them was grounded. Two of the men went down together, and one of them, forgetting that the thing had been changed to alternating, went feeling around to get hold of this socket, and he found it and he laid down on the wet ground, and the other man stumbled over him and spoke to him, but received no answer and he spoke to him again. He stooped and looked at him, and finding that he was growing black in the face ran off to call for help. He ran down to the station and while there learned that the foreman had gone to another building, and he ran after him. By the time he found him and got back the foreman told him the moment he heard something was wrong there he knew what it was. He ran down in the cellar and found this man lying on his back perfectly still and blue in the face. He stooped down and shook him and got a terrific shock himself. He saw that he still had hold of the socket, and he took his coat so that he would not get the shock himself and pulled the wire out of the man's hand, and then they picked him up. He had been then on the current, as near as we could estimate, four minutes, taking the full benefit of a thousand volt current. The men did not know what to do, but fortunately treated him for asphyxia. The man was blue in the face. They cut his clothes open and dashed water on him and tried artificial respiration, and in the meantime sent for an ambulance. By the time the ambulance got there he was sitting up and refused to get into the ambulance, and seemed to be very much disgusted that an old arc light man like himself should be keeled over in that way by an alternating current. The next day he expressed himself as perfectly well and ready to go to work. We had some difficulty in getting him to go and see the doctor but we insisted on it. We were more afraid of the nervous shock than anything else. The doctor told us that he was badly burned. The structure of the skin had been destroyed, as is usual in all electric burns, and the burn had extended some distance under the skin and had followed two or three inches under the skin, and he said that was the real danger in the burn. He said if it was opened up the whole length he would recover with very little trouble The man told us that for two minutes at least of the time he was on the wire he was perfectly conscious, that he knew his companion was there and he tried to tell him to pull the wire away, but he could not speak, and that when the man went away he knew perfectly well he had gone for assistance, and then realized that it would be three or four minutes before he got back, and he thought to himself that he could not stand it that length of time, and then he forgot everything. He said that he felt no particular pain. He got a shock that he would get from any electric current, when he first laid hold of it, but after that he felt nothing. The sensation seemed to be like that of drowning. As soon as we got him to gasp and breathe his color came back again. This incident has given me quite a new hold on the alternating current system—to know that you can take 1000 volts of it and stay on it that length of time. I know I would be very sorry to take a direct current one quarter of that time.

As to the question of machines heating, I would say that on the newer machines such as we are using now, we run them for a week, starting on Sunday afternoon and running until Sunday morning. It runs from nothing—an amount which you cannot read—to 35 or 40 amperes, and in all that time it never gets so hot that you can not bear it with your hand with comfort. On the larger size machines we are using in Pittsburgh—we have one there that has been running two months—a 30 light machine—running twenty-two and three-quarter hours a day. We only stop for ten minutes, and if the engineer does not feel like it he doesn't stop then. The load on that varies from nothing up to 65 or 70 amperes. You can always bear your hand on the machine, and as long as you can bear your hand on it, it is certainly not hot enough to injure any good insulation. The converters we know absolutely nothing about. We put them in and that is the end of it. I think we had to take out two on account of the blowing out of the plugs. The secondaries were short-circuited, the effect of which is generally to blow out the primary plug. It does not injure the converter as far as we have been able to find. We have never had a case of a converter short-circuiting either in the primary or the secondary. We have occasionally had a converter terribly overloaded, when it would heat and finally blow the plugs through another converter which is tapped in on the secondary wire. It is hard to get linemen to understand that where two converters are coupled together and one of them gets hot it is usually the other converter that is at fault. I am little of an enthusiast on the subject of alternating currents, as in Pittsburgh we are using the direct system multiple arc and we have been struggling with 0000 wire pulling our poles out of line and the direct current machine burning armatures. In Pittsburgh we put them to very severe duty, owing to the suddenness with which storms come up there. I have known a current in our station to jump from 300 to 2,000 amperes inside of fifteen minutes. But taking the two systems into account, the ease of distribution, and the ease of handling, I say that the alternating system is bound to come, if for nothing else than the enormous reduction it makes in the cost of running the station.

Dr. MOSES: I am very well pleased to hear some of the details Mr. Smith has mentioned. I feel myself a little responsible for the success of that system, inasmuch as I then thought it would succeed and now I want it to succeed. The alternating current machines which I saw at Pittsburgh were running very well, and had only been running for one month when I made that report to the last convention—as my neighbor facetiously remarks that very extraordinary report. However, I have just returned from abroad, and thought that before coming here I could not spend two days necessary to get over the *mal de mer* better than in going to Pittsburgh and seeing how that machine was running. I am very happy to say that the same machine is running in that station in South Pittsburgh that Mr. Smith speaks of, with this additional fact, that they have doubled up all around in their capacity—not doubling, however, that lone solitary man that Mr. Weeks saw there when he meandered through Pittsburgh and looked at the alternating current system. The same man was there. They had doubled up the capacity, but that same one man was running it, and I did not see that he had any more work to do than he had before. They were running 3,000 lights where before they had been running 1,500. While wandering through Pittsburgh and seeing thousands and tens of thousands of incandescent lights which they have in all directions, I noted the progress that had been made by the principal company there engaged in the alternating current system, and I saw one thing that I would like to call to the attention of this convention as being one of the most important things in connection with the development of alternating electric lighting that I have yet seen or heard of. When I went there six months ago they were making machines of 500 to 1,000 lights. The other day when I went up there I saw a 2,500 light machine running and doing its work admirably well, and here is the thing that is so remarkable and that I will call special attention to. The machine simply seemed to have been looked at through glasses of gradual magnifying power; that is to say, the 500 light machine was of a certain size, the 1,000 light machine so much larger, and so on, but it was exactly the same machine in all its details. In a continuous current machine, if you want to vary the outout of the machine by increasing the parts, you will find yourself, when you begin your work, quite at sea. No one can calculate exactly what he is

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MATHEMATICAL PROPERTIES OF THE METRIC WIRE GAUGE.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Gauge No.	Diameter.		Sectional Area.		Weight per Length.		Length per Weight.		Resistance in Legal Ohms Pure Copper, at 0° Centgr. Ohms per Length.		Length per Ohms.		Logarithms of Sectional Area.		Square.	Nearest Corresponding Number.	
N	Millimeters.	Inches.	Sq. Millimeters.	Sq. Inch.	Kilogr'mes per Kilometer.	Pounds per 1,000 feet.	Kilometers per Kilogr'me.	Feet per Pound.	Ohms per Kilometer.	Ohms per 1,000 Feet.	Kilometers per Ohm.	Feet per Ohm.	Logarithms Square Millimeters.	Logarithms Square Inch.	Sq. of Gauge No.	In Brown & Sharpe Gauge.	In Birmingham Gauge.
1	.1	.0039	.0079	.00001	.0699	.04692	14.306	21313.	2034.2	620.000	.00049	1.6129	-3.8950899	-5.0854427	1	38	36
2	.2	.0079	.0314	.00005	.2796	.18767	3.5765	5328.5	508.23	154.900	.00197	6.4556	-2.4971499	-5.6875027	4	32	33
3	.3	.0118	.0707	.00011	.6291	.42226	1.5896	2368.2	226.02	68.889	.00442	14.516	-2.8493325	-4.0396853	9	29	30
4	.4	.0157	.1257	.00019	1.1184	.75069	.89413	1332.1	127.14	38.750	.00787	25.806	-1.0992099	-4.2895517	16	26	27
5	.5	.0197	.1963	.00030	1.7475	1.1730	.57224	852.55	81.367	24.800	.01229	40.323	-1.2930299	-4.4833827	25	24	25
6	.6	.0236	.2827	.00044	2.5164	1.6891	.39739	592.05	56.504	17.222	.01770	58.065	-1.4513925	-4.6417453	36	23	24
7	.7	.0276	.3848	.00060	3.4251	2.2990	.29196	434.97	41.514	12.653	.02409	79.032	-1.5852859	-4.7756673	49	21	22
8	.8	.0315	.5027	.00078	4.4736	3.0028	.22353	333.03	31.784	9.6875	.03146	103.22	-1.7012699	-4.8916227	64	20	21
9	.9	.0354	.6362	.00099	5.6619	3.8004	.17662	263.13	25.113	7.6191	.03982	131.25	-1.8035749	-4.9939083	81	19	20
10	1.0	.0394	.7854	.00122	6.9900	4.6918	.14306	213.14	20.342	6.2000	.04916	161.29	-1.8950899	-3.0854427	100	18	19
11	1.1	.0433	.9503	.00147	8.4580	5.6771	.11823	176.15	16.811	5.1240	.05551	195.16	-1.9778753	-3.1682281	121	17	19
12	1.2	.0472	1.1310	.00175	10.066	6.7562	.099348	148.01	14.126	4.3055	.07079	232.26	0.0584525	-3.2438051	144	17	18
13	1.3	.0512	1.3273	.00206	11.813	7.9292	.084651	126.11	12.036	3.6687	.08308	272.58	0.1229767	-3.3133297	169	16	18
14	1.4	.0551	1.5394	.00239	13.700	9.1960	.072990	108.74	10.378	3.1633	.09635	316.13	0.1873459	-3.3776991	196	15	17
15	1.5	.0591	1.7671	.00274	15.728	10.557	.063582	94.727	9.0407	2.7556	.11061	362.90	0.2472725	-3.4376385	225	15	17
16	1.6	.0630	2.0106	.00312	17.896	12.011	.055883	83.257	7.9460	2.4219	.12585	412.90	0.3033299	-3.4936827	256	14	16
17	1.7	.0669	2.2698	.00352	20.201	13.559	.049502	75.580	7.0386	2.1454	.14207	466.13	0.3559577	-3.5463405	289	14	16
18	1.8	.0709	2.5447	.00394	22.648	15.201	.044155	65.783	6.2783	1.9136	.15928	522.58	0.4056349	-3.5959877	324	13	15
19	1.9	.0748	2.8353	.00439	25.234	16.937	.039629	59.041	5.6348	1.7143	.17747	583.32	0.4525971	-3.6429615	361	13	15
20	2.0	.0787	3.1416	.00487	27.960	18.767	.035765	53.284	5.0854	1.5500	.19664	645.16	0.4971499	-3.6875027	400	12	14
21	2.1	.0827	3.4636	.00537	30.826	20.691	.032440	48.330	4.6126	1.4059	.21680	711.29	0.5395285	-3.7298815	441	12	14
22	2.2	.0866	3.8013	.00589	33.832	22.708	.029558	44.037	4.2028	1.2810	.23794	780.65	0.5799353	-3.7702881	484	11	14
23	2.3	.0906	4.1548	.00644	36.977	24.820	.027044	40.291	3.8453	1.1720	.26006	853.23	0.6185455	-3.8089073	529	11	13
24	2.4	.0945	4.5239	.00701	40.263	27.025	.024837	37.003	3.5315	1.0764	.28316	929.03	0.6555123	-3.8458653	576	11	13
25	2.5	.0984	4.9087	.00761	43.688	29.324	.022890	34.102	3.2547	.99200	.30725	1008.1	0.6909699	-3.8813229	625	10	12
26	2.6	.1024	5.3093	.00823	47.253	31.717	.02116	31.529	3.0091	.91716	33232	1090.3	0.7250367	-3.9153895	676	10	12
27	2.7	.1063	5.7256	.00875	50.957	34.203	019624	29.237	2.7904	.85048	.35838	1176.6	0.7578175	-3.9481705	729	10	12
28	2.8	.1102	6.1575	.00954	54.802	36.784	.018248	27.186	2.5946	.79082	.38542	1294.0	0.7894059	-3.9797589	784	9	12
29	2.9	.1142	6.6052	.01024	58.786	39.458	.017011	25.343	2.4188	.73722	.41344	1356.5	0.8198859	-2.0102387	841	9	12
30	3.0	.1181	7.0686	.01096	62.910	42.129	.015896	23.682	2.2550	.68730	.44346	1453.3	0.8493325	-2.0396853	900	9	11
31	3.1	.1220	7.5477	.01171	67.174	45.088	.014887	22.179	2.1167	.64516	.47243	1550.0	0.8778133	-2.0681633	961	8	11
32	3.2	.1260	8.0425	.01247	71.578	48.044	.013971	20.814	1.9865	.60547	.50340	1651.2	0.9053899	-2.0957427	1024	8	11
33	3.3	.1299	8.5530	.01326	76.122	51.094	.013137	19.572	1.8679	.56933	.53535	1756.5	0.9321177	-2.1224707	1089	8	10
34	3.4	.1339	9.0792	.01407	80.805	54.237	.012375	18.437	1.7597	.53633	.56829	1868.8	0.9580477	-2.1484007	1156	8	10
35	3.5	.1378	9.6211	.01491	85.628	57.475	.011678	17.399	1.6605	.50612	.60221	1975.8	0.9832259	-2.1735789	1225	7	10
36	3.6	.1417	10.1788	.01578	90.591	60.806	.011039	16.446	1.5696	.47820	.63712	2100.0	1.0076949	-2.1980479	1296	7	10
37	3.7	.1457	10.7521	.01667	95.694	64.231	.010451	15.569	1.4859	.45289	.67300	2208.1	1.0314933	-2.2218461	1369	7	9
38	3.8	.1496	11.3412	.01758	100.94	67.750	.009907	14.760	1.4087	.42936	.70987	2329.0	1.0546571	-2.2450101	1444	7	9
39	3.9	.1535	11.9459	.01852	106.32	71.363	.009406	14.013	1.3374	.40763	.74773	2453.2	1.0772191	-2.2675721	1521	6	9
40	4.0	.1575	12.5664	.01948	111.84	75.069	.008941	13.321	1.2714	.38750	.78656	2580.7	1.0992099	-2.2895627	1600	6	9
41	4.1	.1614	13.2025	.02046	117.50	78.870	.008510	12.679	1.2101	.36833	.82638	2711.3	1.1206577	-2.3110105	1681	6	8
42	4.2	.1654	13.8544	.02148	123.30	82.764	.008110	12.083	1.1532	.35147	.86719	2845.2	1.1415885	-2.3319413	1764	6	8
43	4.3	.1693	14.5220	.02251	129.24	86.752	.007737	11.527	1.1001	.33609	.90897	2982.3	1.1620269	-2.3523757	1849	6	8
44	4.4	.1732	15.2053	.02357	135.33	90.834	.007390	11.009	1.0507	.32025	.95174	3122.6	1.1819953	-2.3723481	1936	5	8
45	4.5	.1772	15.9043	.02466	141.55	95.009	.007065	10.525	1.0045	.30617	.99549	3266.1	1.2015149	-2.3918679	2025	5	7
46	4.6	.1811	16.6190	.02576	147.91	99.279	.006761	10.073	.96133	.29300	1.0402	3412.9	1.2206055	-2.4109583	2116	5	7
47	4.7	.1850	17.3494	.02689	154.41	103.88	.006476	9.6264	.92085	.28067	1.0859	3562.9	1.2392857	-2.4296385	2209	5	7
48	4.8	.1890	18.0956	.02805	161.05	108.10	.006209	9.2507	.88289	.26910	1.1327	3716.1	1.2575723	-2.4479251	2304	5	7
49	4.9	.1929	18.8574	.02923	167.83	112.65	.005958	8.8770	.84722	.25822	1.1803	3872.6	1.2754821	-2.4658351	2401	5	6
50	5.0	.1969	19.6350	.03044	174.75	117.30	.005722	8.5255	.81367	.24800	1.2290	4032.3	1.2930299	-2.4833829	2500	4	6
51	5.1	.2008	20.4282	.03166	181.81	122.03	.005500	8.1944	.78207	.23837	1.2787	4195.2	1.3102303	-2.5005831	2601	4	6
52	5.2	.2047	21.2372	.03292	189.01	126.87	.005291	7.8823	.75055	.22876	1.3324	4371.3	1.3270965	-2.5174495	2704	4	6
53	5.3	.2087	22.0618	.03420	196.35	131.79	.005093	7.5876	.72416	.22072	1.3809	4530.7	1.3436417	-2.5339945	2809	4	6
54	5.4	.2126	22.9022	.03500	203.83	136.81	.004917	7.3092	.69759	.21262	1.4335	4703.2	1.3598775	-2.5502258	2916	4	5
55	5.5	.2165	23.7583	.03683	211.45	141.93	.004729	7.0458	.67245	.20496	1.4871	4879.1	1.3758153	-3.5661681	3025	4	5
56	5.6	.2205	24.6301	.03818	219.21	147.14	.004562	6.7965	.64865	.19770	1.5417	5058.1	1.3914659	-2.5818187	3136	3	5
57	5.7	.2244	25.5176	.03955	227.11	152.44	.004403	6.5601	.62609	.19083	1.5972	5240.3	1.4068397	-2.5971923	3249	3	5
58	5.8	.2284	26.4208	.04095	235.14	157.83	.004253	6.3358	.60489	.18430	1.6537	5425.8	1.4219459	-2.6122987	3364	3	5
59	5.9	.2323	27.3397	.04238	243.32	163.32	.004110	6.1229	.58436	.17811	1.7113	5614.5	1.4367939	-2.6271467	3481	3	4
60	6.0	.2362	28.2743	.04382	251.64	168.91	.003974	5.9205	.56505	.17222	1.7697	5806.5	1.4513925	-2.6417441	3600	3	4
61	6.1	.2402	29.2247	.04530	260.10	174.58	.003845	5.7279	.54667	.16641	1.8292	6001.6	1.4657495	-2.6561025	3721	3	4
62	6.2	.2441	30.1907	.04680	268.70	180.35	.003722	5.5447	.52918	.16129	1.8897	6200.0	1.4798733	-2.6702263	3844	3	4
63	6.3	.2480	31.1725	.04832	277.43	186.22	.003605	5.3700	.51251	.15621	1.9512	6401.6	1.4937711	-2.6841239	3969	2	4
64	6.4	.2520	32.1699	.04987	286.31	192.17	.003493	5.2035	.49662	.15137	2.0136	6606.5	1.5074499	-2.6978027	4096	2	3
65	6.5	.2559	33.1831	.05144	295.33	198.23	.003386	5.0447	.48146	.14675	2.0770	6814.5	1.5209167	-2.7112659	4225	2	3
66	6.6	.2598	34.2120	.05303	304.49	204.38	.003284	4.8929	.46698	.14233	2.1414	7025.8	1.5341777	-2.7245307	4356	2	3
67	6.7	.2638	35.2565	.05465	313.78	210.62	.003187	4.7480	.45314	.13812	2.2068	7240.3	1.5472395	-2.7375925	4489	2	3
68	6.8	.2677	36.3168	.05629	323.22	216.95	.003087	4.6094	.43992	.13408	2.2732	7458.1	1.5601077	-2.7504607	4624	2	3
69	6.9	.2717	37.3930	.05796	332.80	223.38	.003005	4.4767	.42726	.13023	2.3405	7679.0	1.5727881	-2.7631413	4761	2	3
70	7.0	.2756	38.4845	.05965	342.51	229.90	.002920	4.3497	.41514	.12653	2.4088	7903.2	1.5852859	-2.7756389	4900	1	2
71	7.1	.2795	39.5928	.06136	352.37	236.51	.002838	4.2281	.40352	.12299	2.4782	8130.7	1.5976067	-2.7879595	5041	1	2
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73	7.3	.2874	41.8539	.06488	372.50	250.03	.002685	3.9996	.38172	.11634	2.6197	8595.2	1.6217357	-2.8120885	5329	1	2
74	7.4	.2913	43.0085	.06667	382.78	256.92	.002613	3.8922	.37138	.11320	2.6926	8834.3	1.6335533	-2.8239061	5476	1	2
75	7.5	.2953	44.1786	.06849	393.19	263.92	.002545	3.7891	.36163	.11022	2.7653	9072.6	1.6452125	-2.8355653	5625	1	1
76	7.6	.2992	45.3646	.07032	403.74	271.00	.002477	3.6900	.35218	.10734	2.8395	9316.1	1.6567171	-2.8470699	5776	1	1
77	7.7	.3032	46.5663	.07218	414.44	278.18	.002413	3.5948	.34309	.10457	2.9147	9562.9	1.6680713	-2.8584243	5929	1	1
78	7.8	.3071	47.7836	.07407	425.27	285.45	.002351	3.5032	.33435	.10191	2.9909	9812.9	1.6792791	-2.8696319	6084	0	1
79	7.9	.3110	49.0167	.07598	436.25	292.82	.002292	3.4151	.32594	.09934	3.0681	10066.	1.6903441	-2.8806969	6241	0	1
80	8.0	.3150	50.2655	.07792	447.36	300.28	.002235	3.3303	.31784	.09678	3.1463	10322.	1.7012699	-2.8916227	6400	0	1
81	8.1	.3189	51.5300	.07988	458.62	307.83	.002181	3.2485	.31004	.09450	3.2254	10582.	1.7120599	-2.9024129	6561	0	1
82	8.2	.3228	52.8102	.08186	470.01	315.48	.002128	3.1698	.30252	.09221	3.3055	10845.	1.7227177	-2.9130705	6724	0	0
83	8.3	.3268	54.1061	.08387	481.54	323.22	.002077	3.0939	.29528	.08999	3.3866	11111.	1.7332461	-2.9235991	6889	0	0
84	8.4	.3307	55.4177	.08590	493.22	331.06	.002028	3.0206	.28829	.08787	3.4687	11381.	1.7436485	-2.9340015	7056	0	0
85	8.5	.3347	56.7450	.08796	505.03	338.98	.001980	2.9500	.28155	.08581	3.5518	11653.	1.7539277	-2.9442777	7225	0	0
86	8.6	.3386	58.0881	.09004	516.98	347.01	.001934	2.8818	.27504	.08383	3.6359	11929.	1.7640869	-2.9544291	7396	0	0
87	8.7	.3425	59.4468	.09215	529.08	355.12	.001890	2.8159	.26875	.08191	3.7209	12208.	1.7741285	-2.9644813	7569	0	0
88	8.8	.3465	60.8212	.09428	541.31	363.33	.001847	2.7523	.26268	.08006	3.8070	12490.	1.7840553	-2.9744081	7744	00	0
89	8.9	.3504	62.2114	.09643	553.68	371.64	.001806	2.6908	.25681	.07827	3.8940	12776.	1.7938699	-2.9842185	7921	00	0
90	9.0	.3543	63.6173	.09861	566.19	380.04	.001766	2.6313	.25113	.07654	3.9820	13065.	1.8035749	-2.9939279	8100	00	0
91	9.1	.3583	65.0388	.10082	578.85	388.53	.001728	2.5738	.24564	.07487	4.0710	13357.	1.8131727	-1.0035257	8281	00	0
92	9.2	.3622	66.4761	.10304	591.64	397.12	.001690	2.5182	.24033	.07325	4.1609	13652.	1.8226655	-1.0131183	8464	00	00
93	9.3	.3662	67.9291	.10530	604.57	405.80	.001654	2.4643	.23519	.07170	4.2519	13950.	1.8320559	-1.0224085	8649	00	00
94	9.4	.3701	69.3978	.10757	617.64	414.57	.001619	2.4121	.23021	.07017	4.3438	14252.	1.8413457	-1.0316985	8836	00	00
95	9.5	.3740	70.8822	.10987	630.85	423.44	.001585	2.3616	.22539	.06870	4.4367	14556.	1.8505371	-1.0408897	9025	00	00
96	9.6	.3780	72.3823	.11220	644.20	432.40	.001552	2.3127	.22072	.06727	4.5306	14865.	1.8596323	-1.0499851	9216	00	00
97	9.7	.3819	73.8981	.11455	657.69	441.45	.001521	2.2652	.21620	.06589	4.6255	15176.	1.8686333	-1.0589863	9409	00	00
98	9.8	.3858	75.4297	.11692	671.32	450.60	.001490	2.2193	.21180	.06456	4.7213	15490.	1.8775421	-1.0678951	9604	00	00
99	9.9	.3898	76.9769	.11932	685.09	459.85	.001460	2.1746	.20755	.06326	4.8182	15808.	1.8863603	-1.0767231	9801	000	00
100	10.	.3937	78.5398	.12174	699.00	469.18	.001431	2.1314	.20342	.06200	4.9160	16129.	1.8950899	-1.0854427	10000	000	00

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The Convention.

We devote this week's issue of the WESTERN ELECTRICIAN to a verbatim report, from the official stenographer's minutes, of the proceedings of the National Electric Light association in Boston last week. It is needless to indicate the value of the report. The wide range of subjects discussed and the ability of those who participated in the discussions are obvious to even the most casual reader. The attendance was large, as the list of names shows, and was composed of influential men. They met, gained a wider, more extended knowledge of the subjects that came under consideration and departed not only with minds enriched by contact with other minds working in similar channels, but also with vivid recollections of the courteous hospitality of the city of Boston and others, whose guests they were for the time.

The brief space at command precludes any but a superficial view of the proceedings of the convention.

The vexed subject of wire gauge was presented in an admirable manner by Mr. Garratt of that committee. The table of the mathematical properties of the wire gauge which formed a part of the report of the committee we have reproduced in its entirety, well aware that its value to our readers warrants it. Extreme care has been taken in reconverting the table into type and its reliability can be depended upon. After a long discussion of the report of the committee, the convention decided not to promulgate a new wire gauge, but advised the use of the metric system in measuring wire and ordered the table printed.

The patent office was a subject that awakened sharp criticism, and the form of a bill creating a a commission to examine and report to congress needful reforms in the patent office, to be presented to the next congress, was adopted.

The storage battery, a subject that is claiming close attention from electricians at present, was ably treated by Mr. Mailloux and Professor Reckenzaun. Lieutenant Murdoch's paper, on the electrical equipment of the new government cruisers, is full of information. The able remarks of Dr. Waldo, on bending tests of line wire and the properties of silicon-bronze wire, are entitled to careful reading. The report of the committee of the proper insulation of wire and the proper installation and construction of plants and that of the committee on electrical distribution of alternating currents, as well as Mr. Weeks' paper on electrical education, will unquestionably receive the close consideration they are entitled to.

The matter of the undergrounding of wires was only briefly discussed, but at the next meeting it will receive more attention.

The next convention will be held in Pittsburgh in February.

Continued from page 88.

going to get at. True, there is a good deal of pleasure in guessing right, but if you do not happen to guess right, it is very disagreeable and costly. But here in the alternating current machine you see a possibility, under certain forms of the machine, of quadrupling the output without changing the form of the machine at all. Now where is that going to stop? It is only a step to say that they will be making some day in the simplest manner 10,000 light machines that will require no more attention than the same solitary man that we saw at the South Pittsburgh station. The strength of the materials is the only limit to the length of the shaft bearing the armature, and I do not see really where the limit is going to be; so if you want to put in central station work it seems to me that on an alternating current machine, you may do an unlimited amount of work and get rid of all this great trouble you have had in doubling up machines, looking after commutators, and all that difficulty which naturally limits the aid of a plant. That is a fact that I think will be of value to the convention, and I give it.

Mr. KIMBALL: In regard to the alternating system of supplying incandescent lights, since the last convention in Philadelphia, there has been a marked advance, and from the various installations which are at present in operation, we have been able to get data which are not only interesting, but useful, and the question of insulation of the high potential wires is one which appeals to every one in every part of electric lighting stations, whether in the lineman or the central station general manager. In one case it is life and limb; in the other it is property. Regarding the danger of carrying high potential wires into sockets, there are many cases where it is convenient to make an armature instead of putting a converter high upon a fixture in a city where you are not allowed to put it on poles—it is very inconvenient to put a converter for 100 lights on top, of a man's building and carry one or two down into a store to distribute the incandescent light simply because you are running with 52 volt, and if a way can be devised for enabling us to carry safely the currents which, to say the least, approach the intensity of the arc current into our cellars without that sense of danger, it is the thing that is needed at present.

The question of the insulation between the primary and the secondary of the induction coil is one which is governed by a variety of causes. Where converters are placed out of doors, moisture will get in and grounds will develop on the high tension wires, no matter how carefully the poles may be wired, either from defective wiring, as far as relative insulation in positive and negative wire, or possibly we may have ground wires, and this bold expedient of grounding the inside wiring by heavy metallic lines to the ground, has been brought to the attention of this convention before and has been published in some of the electrical papers, and it seems to me that opens a field for discussion. The fact must be appreciated that each system of incandescent wiring from a converter inside a building is entirely separate and completely isolated from every other piece of wiring in the city or town, and that running a metallic ground from one wire to the earth is not to be compared with grounding a positive wire by distribution from 75 to 100 volts, and in such cases, should danger develop, being only on one wire, the lead fuse can give way to an excess of current on either positive or negative that in any way affected the other installation, and in such way give warning of danger, whether in the converter or in defective wiring.

Regarding the distribution of currents over a large area, in discussing a system of running incandescent lights, which requires us to use a little different apparatus, it seems to me that those of us who have the practical work to do are apt to lose sight of the fact that all the laws of wire and construction work which apply to straight incandescent or low tension wiring are not applicable to the alternating system, and that all appliances which are made for straight incendescent work may be utilized for the alternating current by conforming to the laws which are now so well known regarding self-induction and the closed magnetic shield, and it is a question to be decided by the electric light engineers, in practice, whether it is better to rely on high potential wires for a system of distribution and lay them out with as much care as the feeders, mains and systems are now laid out, and then to place the converters as near the lamps as possible—any way they may be required; or whether it is better to run a system of high potential mains and rely on your inside wiring, or your placing of your converters. By inside wiring, I mean this: That in many plants converters are placed in groups, not necessarily together, and connected by a main trunk secondary wire, which is practically the same as the mains in a system of distribution, so that part of the advantages of the alternating system are lost in being able, in addition to the high potential wires, to run a complete set of secondary.

In the example which our friend, Mr. Slattery, gave of the 400-light lamp taken from rough figures, which I have in a note book only—it seems to me that I should arrive at a rather different result in this direction. The problem, as I understood it, was 400 lights, 16 candle power lamps, a mile and a half from the source of generation to the center of distribution. It was suggested that it would require a number two Brown & Sharpe wire, and five per cent. loss. Assuming five per cent. loss from the source of generation to the center of distribution, and something like four or five per cent., I believe, was mentioned for loss in the converters independent of inside wiring, we have a round ten per cent. loss for 400 lights, representing 20,000 watts to be delivered from the dynamo. The addition of ten per cent. for loss would give us 22,000 watts divided by the potential of the dynamo, giving us 22 amperes to be carried through this distance of three miles, and allowing our five per cent. loss—5 per cent. of 1,000 volts being 50 volts—we have 50 volts lost. The 22 ampere current to be carried and the volts divided by the current gives us a resistance of 2 3-10 ohms which could be used in the line, and for three miles of number five wire, which would allow us—the wire having the loss of 3-10 ohms per thousand feet, or about a number five wire, with a loss of five per cent.

Mr. DECAMP: In the report read by Mr. Slattery he speaks more positively about the difficulty of insulating for this current. On the other hand, he notes that the effect of the current upon a person—and he is corroborated in this by Mr. Smith—is not as great as it is on the direct current. That struck me as being a little inconsistent. The electromotive force, as I understand it, is a very strong element to guard against in making installations. It is what affects the human body. I would like to have an explanation of that. There is another thing I would like to know. The peculiarity of this current is such that the close contact is going to affect the currents or going to affect the insulation, making it more or less difficult to insulate. We are about to run an alternating circuit underground in the city of Philadelphia through an iron conduit. Those are things we have got to contend with. Now, shall we make that conductor of an insulation that requires a second metallic covering, such as lead? Do we lessen or do we increase our difficulties by so doing?

Mr. SLATTERY: Right upon that point, before we give any of the other matters that were brought forward any consideration, I would beg to refer to Messrs. Westinghouse, who are in that line and who can render us some valuable information with regard to those special methods of insulation, and I defer to them as having a far greater experience in that direction than I. If they will be kind enough to render the information with regard to the disposition of such a circuit, I should be greatly gratified myself.

Mr. SMITH, of the Allegheny County Light Co.: I would state that I am not in any way a representative of the Westinghouse people, though using their apparatus; but being a resident of the same city, I have had exceptionally good opportunities for observing their work. In Philadelphia we are using lead and copper cables. We use that because it seemed to us in underground work that the first thing we had to look out for was moisture. We satisfied ourselves that if we could get a good metallic covering it would be probably about as good as anything we could get hold of. Our conduit in Philadelphia is made of a common pine box, in which the cable is laid, and the box is filled with pitch. In that we have iron tension boxes for connecting our feeder into our mains. The outside covering of the cable is not insulated in any way from the junction box, though, of course, the wire carrying the current is. In some parts of the street where we found it difficult, owing to water pipes and the cable car conduits, to lay a wooden box, we used the iron pipe through which we pulled these cables and then filled them with pitch. We filled them up with pitch simply as a mechanical protection to prevent workmen from striking a pick into them. We have not had the slightest trouble or loss of current or induction or anything else. Our men handle the outer covering of this cable with perfect impunity, and as long as your dielectric is in good shape it seems to me you have something that is perfectly safe. I understand that some experiments have been made by the Westinghouse company with regard to this very question, and when I put them the question their answer was that we could use any kind of cable we wanted, as long as the covering was good, but for practical use they would recommend us in this particular instance to use a lead covered cable having both conductors in the one light covering; that is to say, two separate cables soldered together through their whole length. They made the test for me. They tested it thoroughly in every way, and told me I would get perfect satisfaction out of it. When we turned the alternating current into our Philadelphia lead-covered cable, where the cables are run in separate boxes but grounded throughout their whole length, the question was raised whether static changes would not come into effect and our men get shocks. But we did not find that there was any effect whatever. As to the question of loss of power through induction passing through a metallic covering it might be different with iron. As I say, I have had no experience with long conduits of iron; but it seems to me that if wires are run close together that any effect on one wire, when it is positive, would be neutralized the next instant. It is the same way with telephone wires. We have found that if we cross our wires every four or five poles we have no effect whatever on the telephone. In one case we have the double circuit about twelve inches apart and the telephone wire running on top of the pole, about seven inches between each wire. There is a continuous musical note, but not nearly as annoying as the buzzing of an ordinary arc machine. Of course we think that the telephone companies ought to cross their wires themselves, but we do not think we ought to be called upon to be public benefactors to such an extent.

On the question of the consistency of the statement that Mr. DeCamp raised: "I have only practical experience. The 50 volt alternating current you cannot feel. On the larger machines we are using the discharge is not so heavy. You take an ordinary arc light machine and you have this immense mass of iron in the field magnet, and when you open the circuits you discharge the field magnet into the line. That is the reason I think that the Thomson-Houston machine gives a so much heavier blow than any other. I have taken these discharges from the field magnets from an ordinary incandescent machine. It is a dead blow and there is a large quantity of electricity discharged at once, but in the armature of the ordinary alternating machine there is so little electricity in it that not much harm is done. We never think of shutting down the machine for the linemen to splice. They climb up the poles and make the connections on live wires. They say they would sooner splice on our lines than on a Brush machine. We have had no case of the men being hurt with it at all. We had one of our men short-circuit a thousand volts current with our switch boards with his plyers. It scared him heavily and burnt the plyers, but it did not damage either the machine or the man.

The PRESIDENT: This discussion has taken a pretty wide range. What disposition will you make of the paper read by Mr. Slattery?

Mr. SLATTERY: May I be permitted to say one word more? I would say simply that I believe the object of this report has been creditably obtained in consequence of the very valuable information elicited from the companies who take a large interest and care in the introduction of this induction business throughout the country. It is extremely gratifying too, the candid spirit in which the information is rendered. The manner in which it is given is almost magnanimous, and I cannot express my approbation of it in too strong terms. Our friend, Dr. Moses, again has placed another future before us. He has given us apparently impossible problems to work out, but he has a singular prescience in his treatment of these matters, and I believe that the immediate future will show the realization of these apparently impossible accomplishments, as the past has well shown the accomplishment of apparently impossible things that he predicted would be accomplished.

A gentleman made the statement about some miscalculation of a wire and aired his erudition in that direction very creditably indeed. He debited me with the statement of a ten or fifteen per cent. loss in the circuit. I am not aware of stating any such loss in the induction system, and by reference to my paper he will be enlightened in that direction. The figures I gave there were simply approximate in regard to cost simply. The loss that I stated was involved in consequence of using conductors and the loss that he stated were entirely different.

I have to again express my great appreciation of the manner in which our report has been accepted by this convention, and I know that I shall receive very great encouragement myself for future efforts in this direction in conjunction with our worthy and excellent opponents. [Applause.]

Mr. KINSMAN: Since I came in I heard one or two gentlemen speak of the information they wanted supplied in regard to this alternating system. I would like to add one thing that may be of interest. I have succeeded perfectly in burning an arc light with a 50 volt converter from the alternating system of the Westinghouse people. We get twelve hours from twenty-four pieces of carbon and a light that is perfectly steady. It was the simplex lamp, 2,000 candle power, 55 volts.

Mr. KIMBALL: I owe Mr. Slattery an apology. In my haste I made a mistake which a better exercise of judgment would have prevented me from committing.. I relied on figures that were scribbled on a piece of paper picked up from the floor and roughed over with a lead pencil, and I beg Mr. Slattery's pardon as his calculations are correct.

Mr. SLATTERY: I beg to accept your very graceful apology, sir. The per cent. of loss I stated in the paper I think was four.

Mr. Slattery's paper was accepted and placed on file.

The PRESIDENT: The next paper is that of E. R. Weeks, of Kansas City, Mo.

Mr. Weeks read his paper on

ELECTRICAL EDUCATION.

Few questions of the day are so important as the applications of electricity, and there are none upon which exist such a lack of general information. The telegraph business is so extensive that people think no more of sending a telegram than of posting a letter; we are beginning to depend upon the telephone as an every day necessity; the electric railway has demonstrated its financial basis, and the electric light, though a creation of yesterday, is so largely used that about two hundred millions of dollars are invested in its manufacture in America alone. In fact, so many are the practical every-day uses to which electricity is put, that we have not time to enumerate them. Yet the public has more knowledge of almost any other instrument of its convenience than of this one force that first inspired the fear and curiosity of man. Not only is the general public almost wholly ignorant of the principles, uses and modes of application of electricity, but there has been such a scarcity of those who have made a special study of these new branches of industry that it has been well nigh impossible to secure the intelligent service that many of them require. A man of average education may easily gain the mechanical dexterity, the sensitive hearing, and the rapidity of thought necessary for telegraph and telephone service, but some applications of electricity require thorough special training for efficient work, and we cannot hope for satisfactory service in the direction of traction and lighting till this training is furnished.

Electrical engineering is undoubtedly the occupation of the future for the young man who does not care to enter the already overcrowded professions, but whose education fits him for a broader field than that of the trades. It holds out the highest inducements financially, and it is a service in which the intellect can never rust out, as it offers a continually widening horizon of thought; indeed, the possibilities of this profession are as yet practically unlimited. In most fields of labor the best has been accomplished; here the work is in its infancy, and the demand is not only for skilled hands, but for trained and progressive minds. The property involved in the applications of electricity is already immense, and is rapidly increasing; much of the machinery used is most delicate—no unskilled hands should destroy its value or make it render less than its best service. "Electricians" to whom Ohm's law is "Greek," and "experts" who "adjust" but never clean, should not be allowed to multiply.

But how can the special education which shall produce true experts and electrical engineers be obtained? Several colleges have given this department some consideration, but not so much as it deserves. Its training should be both theoretical and practical. A thorough understanding of the theory of electricity is absolutely necessary to enable one to keep pace with the rapid progress in this branch of applied science; and without an intimate knowledge of the apparatus used commercial success is impossible. Colleges and universities should have well equipped laboratories, and should add to their curricula complete courses in electrical engineering, laid out after consultation with those few eminent electricians who have had experience in the class-room, the laboratory, the factory, the station, and who know better than any school recluse what theoretical training is of value.

To receive the greatest benefit from such special course, it would be well for the young man, after completing a thorough basic high school course, to spend some months in an electrical station doing the practical every-day work there required, and thus gaining a more nearly adequate idea of the information he will need to give him skilled control of the forces with which he is to deal. With this preparation he will be enabled to take hold of the theoretical work with a zest that can come only from an understanding of what it is to do for him and what he is to do for himself. Having finished his college course, he is not yet to consider himself a graduated expert, but some time spent as a learner in factories and stations should be a regular part of his electrical education.

After fully carrying out such a plan, the young man will be in possession of a theoretical and practical knowledge of the work he has chosen, that will give him access to the most desirable of positions.

The more complicated electrical industries are of such recent date, and their growth has been so rapid, that school-trained workmen could not be obtained. Schools had not time to adapt themselves to the new order of things. Only unskilled labor could be employed, and only such can be had for some time to come. Much of this work has been performed by uneducated men, many of whom have shown that good results may be accomplished without school training or higher mathematics. Thoughtful observation and practical experience have done well for them, but always at the expense of costly mistakes and delays; and at best, such labor is limited in its possibilities. Only the trained mind can attain the highest places.

But something should be done to assist the vast army of halting hands that in the near future—nay in the very present—must do the work, while the schools are preparing for this new field of labor. Ours is not an industry with long years of experience to draw upon, yet it is one in which the unexpected, the unprovided for, is constantly occurring. Therefore interchange and comparison of thought and experience are more necessary here than in other industries of greater age or slower growth. Had this been fully realized in the earlier history of electricity, much of the bungling work of the past might have been avoided; for there can be no doubt that the progress in intelligent service has been greatly retarded by the narrow policy which refused to impart information to the "new man," but which is giving away before the broader influence of our associations. Members of the electrical fraternity are beginning to recognize the truths that knowledge given away is the more securely possessed; and that as all know more than one, all may be benefited by an interchange of ideas; and employers are awakening to the fact that they must also be educators.

In order that the skill and intelligence of the worker may in some wise keep pace with the rapid progress of electrical invention, every mode of improvement should be employed. The public should be informed upon these subjects and led to take an interest in them. Young men must learn that there is a new, broad and remunerative field of honorable and attractive service.

The National Electric Light association is doing much, and should do more, not only for the mutual advancement of its members, but to bring the business which it represents before the public in an intelligent way, not at all as an advertisement, but because it is safer, pleasanter, more profitable, to serve a people well informed upon our work than one whose fears are multiplied through ignorance. The Edison Association and the Institute of Electrical Engineers are also exerting an influence in an educational way, and the clubs that are springing up in all electrical centers, cannot fail to accomplish a good work in the same direction.

But such organizations, however valuable they may be, can affect but indirectly the large body of men who handle machines and lamps, run lines or serve in any of the branches of a business that needs intelligence even in its firemen. Yet these are the men upon whom the success of the new industry must largely depend. As intelligent service is the most profitable, employers can afford to spare no expense to obtain it. Every station should possess a pleasant reading room well stocked with papers, magazines, and standard books on electrical and kindred subjects, and employes should be made to feel it a part of their daily duty to inform themselves upon all matters connected with their work. From time to time they should be questioned upon important points; and if they can not be led to do the necessary reading in any other way, they might have monthly grades and ranks determined by the information they have gained from their work in the reading room. All large stations should have mutual improvement societies of its men, furthered and assisted in a personal way by employers, in which the problem of daily work may be discussed, and directions given for useful and telling study by employes who do not well know how to help themselves.

Municipalities should appoint boards of examiners whose duty it should be to inquire into the competency of electrical employes, especially those of light and power companies, as ignorance and poor workmanship here endanger both life and property. Line and station foremen should be licensed, as their duties are fully as responsible as are those of stationary engineers.

By such legal measures, faulty construction will be prevented, and cities will secure safe and efficient service for the public; will further the interests of workmen; will protect electrical investments, and assist in the education of the people.

The paper was accepted and ordered spread on the minutes of the association.

Mr. SMITH, of Jamestown, N. Y.: I would like to ask if Mr. Weeks could recommend to the convention any practical text books which could be put in the hands of linemen for use in their everyday duties.

Mr. WEEKS: There are a number of books which are sufficiently popular in their style to be of great use to employes. We have a society of our employes in Kansas City on the plan that I have pointed out here, and we have made it a complete success. I think that if Mr. Smith will get a list of electrical books from any one of the electrical papers that he will be able to select from thirty to forty books, sufficiently simple and elementary to form a nucleus for a library of this kind.

Mr. GARRATT: I would say in that connection that I found a little work by Sylvanus Thompson, known as "Elementary Lessons in Magnetism and Electricity." It is a very valuable little work, inexpensive and contains enough material to keep the average workman busy for a long time.

Mr. MASON: There is handed me the following resolution which I have been requested to read. I will read the resolution and append another:

Resolved, That the work that was assigned to the committee on insulation and installation is of such importance that this convention can not allow the subject to escape their earnest attention; that the subject is of the utmost importance to the electric light interests and one in which there must be abundant material and experience which can be obtained without expense to this association, and further that another committee should be at once appointed to gather information, classify the facts and then offer them to the convention in form that may be of practical as well as of scientific advantage.

I add this resolution:

Resolved, That a committee of five on insulation and installation be appointed to report at the next meeting and that Doctor Otto Moses be the chairman of this committee.

Dr. Moses demurred, but the motion to appoint a committee of five was carried, the president stating that he would endeavor to induce Dr. Moses to serve on the committee, if not as chairman, as one of its members.

The PRESIDENT: With Col. Leggett's consent I will place him on the committee on revision of the by-laws. There are two points which he made this morning and which I concede to be of the greatest importance;—First, that the convention should decide where the next meeting of the association shall be held; next that they should elect for president of the association some one of the locality selected for the meeting, for I believe that rotation in office is a good thing. I have passed the time when I am seeking particularly after glory and would be very glad to resign the glory and labor to some more competent hands. In making up these by-laws I think it would be weak to consider that part of the proposition. The business of the association can be better handled if the president of the association is chosen from the location in which you intend to hold your next meeting. I assume, Col. Leggett, that you will serve on that committee.

Mr. LEGGETT: I think, inasmuch as I was cut off in my remarks this morning, that it would be fair for me to say that, so far as I am aware, there could have been no better service rendered to our association than has been rendered by our present officers, and especially our present chairman; but it seems to me that it is a matter of considerable importance that these officers should be rotated for the special reason which has just been mentioned by the chairman. The meeting in a certain locality ought to carry with it as nearly as practicable the election for that year, at least, of the officers of the association in the same immediate vicinity, and then again we might at some period be burdened with certain officers whom we did not like, and through a sentimentality which might grow up in this way be burdened in a manner of which we might not care to relieve ourselves. While I am very happy to say, and I know I reflect the sentiments of every member of our society, that the present officers have served us with great ability, I think that that could be made a part of the constitutional groundwork of our association in order that no difficulty or no embarrassment arise hereafter in the organization of our society or in its meetings. It was my purpose in speaking this morning to suggest that it be made an element of our by-laws, of our constitution, in fact; that for the position of president and vice-president—I think it ought not to apply to the secretary and treasurer, because their duties are of such a character that they may properly, with great benefit, be maintained in the same hands for a considerable period—nobody be eligible for two successive terms.

Mr. Mailloux moved that a committee on nominations and place of next meeting be appointed by the chair. The motion was carried, and the president named as such committee Messrs. Mailloux, Leggett, Robertson, Dr. Moses and Mr. DeCamp.

On motion of Mr. DeCamp the convention adjourned until 10 A. M. the following day.

WEDNESDAY MORNING'S SESSION.

The convention was called to order at 10:30 o'clock by Ralph W. Pope, and Frank Ridlon was chosen temporary chairman.

Lieutenant J. B. MURDOCH, U. S. Navy Electrician at the Torpedo Station, Newport, R. I., read the appended paper on

THE ELECTRIC LIGHT OUTFIT OF THE NEW GOVERNMENT CRUISERS.

The question of how to best install the electric lights in the new men-of-war has been considered in detail, and it seemed advisable to bring the matter before the National Electric Light Association, that the manufacturers of the country might have the problem presented to their consideration in advance of the time when they would be asked to act upon it. In conversation with managers of various companies, it has been impressed on my mind that the peculiar conditions existing on shipboard are but imperfectly understood, and as a natural consequence they have not as yet been as satisfactorily met in this country as abroad. I am confident that American ingenuity and skill can fully meet our requirements, and hope that the number of dynamos, about sixty, which will be needed for the vessels already authorized by congress, may be considered as meriting the experiments necessary for their successful installation.

I am authorized to present in a general way the views

of the Bureau of Ordnance of the Navy Department, on the peculiar conditions to be met, and on the best method of meeting them.

In men-of-war the prime requirements of all kinds of apparatus are compactness and lightness. Neither of these is of any material consequence in electric light installations on shore, and both are generally ignored. Attention has there been given mainly to the question of efficiency of conversion, and a glance at the advertising columns of any of the electrical journals, shows that the maximum efficiency and best system of electric lighting is possessed by each of a dozen companies. Our conditions, so far as the dynamo is concerned may be summarized as wishing the greatest electrical output for a given weight and bulk, and although at first thought this may seem to be essentially the same thing as efficiency of conversion, it is widely different.

The following figures of well known American dynamos illustrate this point. The comparison is made on the basis of "Watts of output per pound of dynamo." The weight, speed and electrical output have been obtained in general from the manufacturers, and are given of course only approximately. In this comparison it is of course necessary to consider also the sizes and the number of revolutions, the watts per pound increasing with large machines and high velocities.

Dynamo.	Revolutions.	Watts in External Circuit	Watts per pound.
Edison, No. 20,	800	50.000	6.0
Brush, H. 3,	850	66.000	9.4
American, 50 Light,	875	21.600	5.7
Westinghouse. No. 18,	900	30.000	5.4
Hochhausen, No 8,	1000	35 200	8.8
Mather, 500 Lights,	1050	35 250	7.4
Weston, 6 W. I.,	1050	11.500	4 1
Brush, G. 4,	1050	28.300	9.3
American, 50 Light. Hie.,	1075	6.480	4.8
Weston, 7 W. I.,	1100	20 125	6.6
Westinghouse, No. 12,	1100	18.000	4.
Brush, F. 5,	1100	19.000	8.5
Thomson-Houston, H.I.,	1150	25.600	6.1
Edison, No. 12,	1200	30.000	6.9
Hochhausen, No. 6,	1200	17 600	8.
Thomson-Houston, E. I.,	1250	13 200	5.8
Mather, 400 Lights,	1300	28.100	7.0
Edison, No. 8,	1400	20.000	6.9
Thomson-Houston, C. I.,	1500	6.000	5.6

The next consideration is that of the connection of the dynamo to its engine, a starting point is afforded in the rule that belting should never be used on a sea-going vessel. Nothing so radically violates our condition of economy of space as the use of belting. When space is saved by the use of a short belt, the working conditions are comparatively unsatisfactory. Belts are liable to be thrown off by the sudden change of load to which our dynamos are subject, and become a source of danger to the attendants if the ship is rolling heavily. The adoption of fixture gearing between engine and dynamo has been suggested, and is probably practicable, but its durability on shipboard, when the motion of the vessel must cause working of the two shafts, may not be great. In the navies of Europe the practice of direct connection is universal, the dynamo shaft being coupled to that of the engine. This calls, of course, for either a great reduction of the speed of the dynamo or a corresponding increase of that of the engine. It is easy enough to procure an engine running 1.500 revolutions per minute, but it is a very different matter to find one which will govern satisfactorily at so high a speed. So far as I can ascertain there is no automatic engine manufactured in the United States capable of indicating thirty horse power which is designed for a higher speed than five hundred. I have been informed, however, that some of the type now in the market could be modified so as to operate well at five hundred. I am not aware of any dynamo in the United States absorbing thirty horse power, which would yield its normal out-put at even the higher speed. It is much easier to reduce the speed of the dynamo while preserving its electrical out-put than to raise the speed of the engine. Admitting the desirability of direct connection on shipboard, the problem proposed is the best method of obtaining the same out-put in watts per pound, at speed below 500, that are now commonly obtained between 1,000 and 1,500.

The following figures of European dynamos obtained in same way as those already given for American machines, and probably equally accurate, will show how this problem has been met abroad:

Dynamo.	Revolutions.	Watts in External Circuits.	Watts per Pound.
Manchester, No. 6,	350	9.000	3.6
Victoria, H. 3,	350	36.000	9.7
Siemens & Halske,	350	16.000	8.1
Edison Hopkinson, 10 in L.	350	16 800	2.9
Manchester, No. 7,	400	22.500	4.6
Victoria, F. 3,	400	21.600	8.6
Siemens & Halske,	400	20.000	10.2
Edison-Hopkinson, 15 in S	420	39.600	3 4
Gramme, H. 2 d 225,	450	23.600	8.3
Elwell-Parker,	450	50.000	5.6
Crampton, $\frac{40}{110}$ J.,	460	45.100	6.7
Edison-Hopkinson, 8 in L	525	15.400	3.3
Manchester, No. 5,	525	6.500	4.7
Crampton, $\frac{22}{110}$ J.,	550	24.750	6.0
Manchester No. 6 A,	550	25.000	6.75
Edison-Hopkinson, 10 in L	550	25.200	4.4
Victoria, D. 2 S.,	600	8.400	6.7
Gramme, H. I. c 200,	600	14.000	6.4
Ganz,	670	50.400	9.2
Crampton, $\frac{60}{110}$ J.,	675	66.000	9.8
Goolden-Trotter,	765	16.000	6.2

It is necessary to only refer incidentally to a few of the methods by which these results have been obtained. The principal are the elimination of all iron not needed for the magnetic circuits of the dynamo and the adoption of a type in which this circuit furnishes a framework of necessary rigidity. The magnet core should be of the best wrought iron, this single condition frequently reducing the weights twenty-five per cent. while preserving the out-put. Armatures of large diameter give high perpetual velocity at low speed, and this seems to recommend the Gramme ring, a large drum armature being cumbersome. The Gramme form has another advantage for ships' use, that it can be repaired or even rewound with the facilities existing on shipboard, although I believe a Siemens winding has recently been perfected which admits of equal facility of repairs. The use of multipolar machines contributes to lightness, and the Siemens and Halske machine referred to in the preceding table has fine field magnets inside a Gramme ring. Flattened ring armatures and multipolar magnets also give large out-put for the weight.

Every ship, aboard which the electric light is a necessity, should have two similar dynamos, that either may be used at will. At present this precaution is not observed in the navy. The lighting of the ship by incandescent lamps is under the control of the Bureau of Navigation, and the installation for this purpose consists of an ordinary plant of an engine driving a dynamo by belting. The electric search lights, two of which are furnished to each large vessel, are supplied by the Bureau of Ordnance, the installation for this purpose consisting of a Brotherton engine driving two C. Grammes connected direct on the same bed plate. In case of accident the incandescent dynamo will not work the search lights to advantage, nor will the Grammes operate the incandescent lights well. This is, of course, most unsatisfactory, and the need of the service is for a dynamo which will perform either work well, and, if necessary, both at once. Our search lights require about fifty volts and fifty ampères for ordinary work, the current being sometimes increased to one hundred. The lamp is operated by hand in order to fully utilize the radiation from the crater of the positive carbon. The hand lamp and Mangin projector are in use in nearly every navy in the world for projecting a condensed train of lights to a distance. Automatic lamps do not admit of continuous adjustments as readily as the hand lamp, and are not so thoroughly under the control of the operator. In any search lights the arc may sometimes fail, and it is sometimes advisable to cut the lights out without notice. Large and sudden variations of load are thus liable to occur, and these should not affect the dynamo. It is unquestionable that incandescent lights can be worked from a series dynamo and search lights operated by a shunt machine, but most of these proceedings are makeshifts. It is undeniable that both search lights and incandescent lights can be worked satisfactorily by a compound dynamo. I have been called upon to work all these kinds of dynamos for each purpose, and the compound dynamo works incandescent lights as well as a shunt machine, and search lights better than does the series machine supplied for the purpose. I have also worked two search lights and fifty incandescent lights simultaneously from one compound dynamo. Each search light had three tenths of an ohm dead resistance in circuit to bring the difference of potential down to about fifty volts. There is nothing new in this, but I have so frequently been asked what advantage the compound dynamo possessed that I have trespassed somewhat on the time of the convention to give reasons for the opinion that all naval dynamos should be compound wound for a constant potential.

It is probable that many fine new vessels will require electric motors. Some of our gun carriages may be worked in this way, on account of the advantages that an electric motor offers in small weight and bulk, and the important fact that it is so much easier to splice a broken main than to patch a leaky pipe when steam or compressed air is used for power. Electric motors will be useful for shell hoists and ammunition whips, reducing the number of men employed for these purposes. Here, also, light weight and compactness are absolutely essential, and nine-tenths of the motors in commercial use would be barred out as too heavy. A ten-horse power motor, the largest we would probably use, should not weigh over five hundred pounds.

The potential at which the main should be kept, must be determined from the relative importance of the three uses to which our dynamos will be put. As we are not bothered by the question of long distance transmission, we can well use a law potential for incandescent lights and motors, while search lights require only fifty volts, although it is advantageous with any dynamo to have a little dead resistance in the search light circuit. For these reasons I think seventy volts is about the best point for a compromise. This is the voltage used in the French navy, the English working at eighty. If ten search lights can be successfully worked in series, the potential at the dynamo might advantageously be raised to one hundred and ten, or even one hundred and twenty volts. Experiments have been made to test this point, but we are not decided as yet. Should there, however, be any material advantages secured in the working of either incandescent lights or motors by the use of a high potential, the search lights could be operated with sufficient resistance to give them their proper potential.

The same requirements of small bulk and weight must control in the choice of engines. The adoption of a compound dynamo throws extra responsibility on the engine, as without constant speed the advantages of the dynamo are not apparent. American automatic engines can easily meet this demand, but most of them are too heavy, rigidity of frame, being unnecessarily large masses of cast iron. One hundred pounds weight per indicated horse power, with 80 lbs. steam, is a liberal allowance. In many European engines, steel and phospher bronze have been largely used to obtain lightness.

It may be interesting to compare a few well known dynamos as to compactness, the comparison being made on watts of out-put per square inch of floor space.

Dynamo.	Revolutions.	Watts in External Circuits.	Watts per square in. floor space.
Manchester, No. 6,	350	9.000	4.9
Edison Hopkinson 10inL	350	16.800	6.9
Manchester, No. 7,	400	22.500	6.0
Edison-Hopkinson, 15inS	420	39.600	9.1
Crompton, $\frac{40}{110}$ J.,	460	45.100	20.3
Edison-Topkinson, 8 in L	525	15.400	6.5
Manchester, No. 5,	525	6.500	4.6
Ganz,	670	50.400	20.9
Crompton $\frac{60}{110}$ J.,	675	66.000	26.4
Edison, No. 20,	800	50.000	8.8
Brush H^8,	850	66.000	23.5
Westinghouse, No. 18,	900	30.000	5.8
Hochhausen, No. 8,	1000	35.200	15.0
Mather, 500 Lt.	1050	35.250	8.5
Weston, 6. W. I.,	1050	11.500	4.4
Brush G^4,	1050	28.300	17.7
Weston, 7 W. I.,	1100	20.125	5.4
Westinghouse, No. 12,	1100	18.000	4.7
Brush F 5,	1100	19.000	15.3
Thomson-Houston, H.I.,	1150	25.600	9.0
Edison, No. 12,	1200	30.000	7.7
Hochhausen, No. 6,	1200	17.600	13.3
Thomson-Houston, E. I.,	1250	13.200	8.2
Mather, 400 Light,	1300	28.100	7.3
Edison, No. 8,	1400	20.000	6.0
Thomson-Houston, C. I.,	1500	6.000	5.9

As illustrating the advantages of direct connection in economy of floor space and of weights when care is taken, I have a few statistics of ship installations: (See Table IV.)

Table IV shows a general average of about forty pounds dead weight of dynamo and engine for each sixteen candle lamp, whether high or low speed dynamos are used. As shown in Table V, special attention has been paid to the manufacture of light and compact apparatus.

It is noticeable abroad that with the type of slow speed dynamos established in the markets the system of direct connection is adopted in many isolated plants on shore. The tendency throughout Europe is to reduce the speed of dynamos, preserving the electrical out-put by a careful study of details. Few recent machines built abroad are designed for higher speeds than 800, while an American company operating at and above 850 advertises slow speed as one of the advantages of its dynamos.

In this country the naval demand for slow speed dynamos will be comparatively small, but if it serves to introduce the type into the market, I am satisfied from what has taken place in Europe that the system of direct connection will create a field for itself, as soon as the apparatus can be procured without the heavy expense attendant on special work. It recommends itself in any installation where either weight or floor space is to be economized. I believe it can be successfully utilized in lighting railway trains, especially if, in the near future, railroad companies have to furnish steam for heating purposes. Plants could be furnished small steamers and yachts, in which a common installation could not find room.

There are one or two other considerations governing ships' installations. The principal is the absolute necessity of high insulation. The Bureau of Navigation has, in its recent contracts, called for an insulative resistance of one thousand megohms per nautical mile, after twenty-four hours immersion in salt water.

That covering is also required as a protective against mechanical injury. We are so exposed to short circuiting and corrosion from salt water that the high standard called for is most wise. All switches, junctions, and safety boxes, and in fact all parts of the circuit, should be thoroughly insulated. Difficulty has been experienced from salt water running along the wires into lamp sockets, short circuiting the lamps. The insulation of the whole circuit is sometimes required to be at least one thousand ohms, for each volt at the terminals of the dynamo.

Lieut. MURDOCH continued: One or two things occurred to me while reading the paper. Things which are necessary in marine installations are measuring instruments, both ammeters and voltmeters which are independent of both gravity and magnetism. We want some kind of an instrument like a dynamometer, perhaps, or something of the kind which would be independent of the earth's magnetism and would not be affected by the local magnetism of the ship. Another thing which is necessary is the independence of the needle from the effect of the rolling of the ship. This has been already met by Sir William Thompson in his marine galvanometer, and, I think, in some recent instruments which I have not yet seen. The simplest way, apparently, is to suspend the magnet, or needle, or coil by a suspension which passes through its center of gravity. If this is accurately done, of course, the force of gravity has no moment to act upon and the rolling of the ship does not affect the needle at all. I was requested to present these facts to the consideration of the convention, and I have to express my thanks for the courtesy extended in affording me the opportunity to do so.

Dr. MOSES: I listened with great pleasure to that very interesting paper, and as there are some points in it which are of very great interest to a large class of our nomadic population, I would like to ask some questions of Lieut. Murdoch in regard to some statistics which he has omitted. Will he kindly let us know whether he has gathered any information as to the relative methods of laying wires on board ships; that is, are grounds used? Is the hull of the ship used as one of the conductors, or is there a tendency to have the circuits entirely independent of the ship itself?

Lieut. MURDOCH: In England, I know, they use what they call the ship return, or as they prefer to put it, the one-wire system, but I do not think anything of the kind has been used in this country, and I should think it highly objectionable. All the installation required is protected by the highest attainable insulation—a double circuit and every part insulated. The system of earth connections

has been used for quite a long while in torpedo service. Much of the torpedo apparatus in the navy has, until within the last few years, been arranged to work with the earth, but premature explosions have taken place, and that has been discarded. To-day, as far as I know, all plants are installed with two wires and high insulation.

Mr. KINSMAN: I would like to ask the gentleman if he knows anything about the experience of the steamship Alaska. They were at one time giving the one-wire system a test.

Lieut. MURDOCH: No, sir. I know they are using the one wire system on Mr Vanderbilt's yacht, the Alva.

Dr. MOSES: I was crossing in the steamer Bourgogne of the Compagnie Transatlantique and we had a very rapid passage. When about four hours from Havre, people began to be disturbed because the previous ship, the Champagne, had been run on the rocks at about that distance from Havre. We were talking of the matter and all of a sudden we saw a stir about the ship and found the captain and one or two officers disappear, and we all made a start to find out what was going on. We found about twenty feet of the molding smoking heavily and the firemen were at work tearing it down. When we got there we found there was the beginning of what might have been a serious fire; it was started by the defects that Lieut. Murdoch spoke of in the insulation. It is the hardest thing in the world to keep an insulation on a sea line. All of you who have houses at the seashore have noticed that where the verandah or piazzas are painted with metallic paints that there is a tendency to a decomposition by the chlorides of the sea air attacking the carbonates, decomposing them and making them soluble as chlorides of lead or zinc and you have the bare wood towards the sea and the rest of it nicely painted. If you want to make a good paint for a sea house use the worst paint you can get—that is carbonate of baryta, which would not be decomposed. All these insulations are affected by the chlorides that come from the salt breeze. In the case of the ship the hull was used for the return wire and I found the crew and officers were always on pins and needles for fear fires would break out. Further investigation developed the fact that there had been an accident of the same kind previously.

Mr. MAILLOUX: I would like to ask Lieutenant Murdoch a question relative to the number of hours during which the energy is to be employed on board ship;—whether the time of use will be pretty well distributed over the twenty-four hours of each day or whether there will be parts of the day when the source of energy will be at rest.

Lieut. MURDOCH: I suppose that ordinarily the incandescent light burns all night from before sunset until after sunrise. In some of the vessels, as in the monitors, I imagine the incandescent circuit may be partially used all the time.

Mr. KINSMAN: I would like to ask the gentleman as to the average light of the incandescent lamps on board ship as compared with that on terra firma.

Lieut. MURDOCH: I think there we work with a large factor of safety. I have been on board only one vessel installed with the electric light. I found that 16 candles gave sufficient light when burned at 13. When a vessel is going on a long cruise it is a great advantage to save the lamps.

Mr. KINSMAN: Do you think light would be as long under similar circumstance?

Lieut. MURDOCH: I think so, yes. As far as the lighting is concerned, the only difference is in the vibration, and there may be some kind of carbon that would not be effective.

A MEMBER: I should like to ask Lieut. Murdoch whether he has ever tried on board ship those meters that are protected by an iron shield which renders them independent of any magnetic influence? There is no necessity for the meter to be put perfectly level upon any table on any particular spot where the measurements are taken. I should like also to point out in connection with this subject that in British men-of-war it is the tendency to use the double wire system, because by using the ship's side as a return there is a large liability for leakage, as pointed out by Dr. Moses.

	PLANT.	Connection.	Total Weight	Floor Space.	Weight per 16 c. lps.	Sq. in. of floor space per 16 c. lps.
U. S. Steamer "Chicago."	2 Edison No. 8 (200 lights) . . . . 2 Armington & Sims	Belting.	16.000		40	
U. S. Steamer "Boston."	1 Brush Compound (150 lights) . . . 1 Straight Line	Belting.	10.400		70	
U. S. Steamer "Atlanta."	1 Weston 7 W. I. (156 lights) . . . 1 Armington & Sims	Belting.	6.500	105 sq. ft.	43	101
Steam Yacht "Alva."	1 Siemens' Compound (160 lights) . . 1 Willan's Engine	Direct 450 Rvs.	8.700	27	43	24
French Ironclad "Indemptable."	2 Plants each . . . . . . 1 Multiplex Gramme (160 lights) . . 1 Verticle Compound Engine . . .	Direct 350 Rvs.	7.040	29	44	26
Torpedo Station.	1 Brush No. 7 Special (100 lights) . . 1 Westinghouse	Direct 700 Rvs.	4.000	17	40	25
Torpedo Station.	1 Weston No. 8 Special (270 lights) . 1 Westinghouse Automatic	Direct 390 Rvs.	9.300	75	42	41

TABLE IV.—LIEUT. MURDOCH'S PAPER.

Lieut. MURDOCH: I have not been able to use the spring meter on board ship. With a Cardew voltmeter the needle would vibrate about four volts, and with the Perry *ammeter* it seemed to vibrate about the same number of amperes. I don't know of anything in the market to-day better. I believe in the British navy they have been using a portable form of Siemens' dynamometer, and some of them have been ordered here to be tested.

Dr. MOSES: Signaling, I presume, is a very important thing on war ships, and it is very necessary that you should be able to use both small and large lights. Now, is it your experience that a 100 or 110 volt circuit is adapted to the use of arc lights, or would it not be preferable to have a 50 volt circuit on board ship so as to be able to use your arc lights directly in multiple arc?

Lieut. MURDOCH: I have recommended in the paper 70 volts. Of course, our experiments with these search lights have been going on a great many years, and the general tendency seems to be that at least a tenth of an ohm dead resistance has a very steadying effect on the light, no matter whether we use a hand lamp or an automatic lamp. A little dead resistance seems to give us better working. The search lights are used so seldom and our general method of working is so economical that we do not care for the energy we waste in these dead resistances. The search lights themselves are of French manufacture, though I think the Brush company of Cleveland have made essentially the same apparatus. I must confess, perhaps, to a little disinclination to use an incandescent lamp at 50 volts. I would rather take a little higher potential and work a lamp about four watts per candle and try to get more light in a shorter time.

	PLANT.	Connection.	Total Weight.	Floor Space.	Weight per 16 c. lps.	Sq. in. of floor space per 16 c. lps.
	1-200 Light Brush Compound . . . 1 8 in. Brotherhood	Direct	5.500		27½	
Steam Yacht "Restless."	1 Arnold Dynamo (30 lights) . . . 1 Vertical Engine	Friction.	600	6 sq. ft.	20	29
	1 Goolden-Trotter Dynamo (75 lights) 1 Tower Engine	Direct.	900	5¼	12	11
	1 Victoria Dynamo (60 lights) . . . 1 Brotherhood	Direct 765 Rvs.	800	$4\frac{6}{10}$	13	11
Italian Cruiser "Dugali."	1 Parson's Dynamo (150 light) . . . 1 Parson's Steam Turbine . . . . (3 plants like above.)	Direct 9000 Rvs.	900	6¼	6	6

TABLE V.—LIEUT. MURDOCH'S PAPER.

Dr. MOSES: Have you ever seen the installation on board the United States fish commission steamer Albatross?

Lieut. MURDOCH: I am familiar with the details but have never been on board the vessel. They use the old Edison B lamp. Of course if we want to take a B lamp with 55 volts we can do it better than with a 16 candle lamp of the same potential.

Dr. MOSES: On a recent visit to Pittsburgh I saw everywhere an installation of 50-volt lamps. It appears that the Westinghouse company of Pittsburgh have adopted that as a standard. Their reason for adopting it, as I am told, is on account of the economy of the lamp. They get more watts per candle power. That, it seems to me, also permits of the use of arc lights directly in the circuit. Incandescent light people, as a rule, neglect the arc lamp and arc light people neglect the incandescent light. It seems to me there should be an imitation of the harmony that prevails here and they should unite in one system the advantages of all. Arc lights should be used with incandescent lights, and yesterday someone, I think Mr. Smith of Pittsburgh, suggested that an arc light can be used direct from converters. If Mr. Smith is present he will confirm or deny it, but I presume it must have been on a 50 volt circuit.

Mr. SMITH: It was Mr. Kinsman of New York who mentioned that. It was news to me.

Mr. KINSMAN: Some seemed to question the ability to run on very high voltage. They asked me if it was possible, after the adjournment. I have run them equally well on 100 volt converters.

Mr. DECAMP: May I ask if there is any loss of current in running it on a hundred volt current?

Mr. KINSMAN: They are obliged to lose some. I have not the data with me. We have reduced it very much from what it was a few months ago, and we hope to eliminate the whole of it, and think we shall very soon.

Dr. MOSES: The discussion brings out such facts that have occurred to me that will answer some of the points that have been raised and some of the questions asked. I happen to have made the first experiments on board the steamship Albatross that I spoke to Lieutenant Murdoch about, with the use of an arc light on incandescent light circuits. It was a 55 volt circuit. It was a lamp directly in the circuit and the lamp was invented to run in incandescent light circuits. While there, it was found, after a great many experiments, that there was a normal length of arc. You may, of course, draft lamps for any voltage, but it is found by experience, taking carbon in its chemical composition and the tendency to an extinguishment of the arc, that a certain length of arc, perhaps from an eighth to a quarter of an inch is best adapted to arc lighting. For that reason it is necessary to have about 45 volts between the terminals of the lamps, and if you are running a 55 volt circuit it gives you that limit of loss which enables you to run out to any length right from the incandescent circuit on the ship. In this particular case there was about one eighth of an ohm put in. It worked very satisfactorily. There was no winking of the lamps at all. The lamp itself was invented for a 55 volt circuit; but the difficulty of putting lamps in series on a multiple and circuit is so great that it is not advisable. Therefore, the adoption of a 50 or 55 volt s andard enables us to harmonize the arc and incandescent light in a most remarkable way. You can use your lamps directly from the circuit and there are places of course, no one will deny, where an arc light is far superior to an incandescent light. It gives you five times as much light per pound of coal burned and for large spaces it is very much more useful; so that it will be very desirable to adopt some general system where arc lighting and incandescent lighting could harmonize.

Mr. KINSMAN: The lamp that I have reference to has been wound so that we have successfully burned two lamps, that is multiple series, on a 110 volt current. I have not the slightest doubt but that can be successfully done by the lamp in a very short time. That brings the thing down to a commercial basis and under all conditions.

Dr. MOSES: But you must use two lights together. If you only have one you are compelled either to throw your superfluous power into resistance or into the light that is in use.

Mr. KINSMAN: In general installation, we are not going to put up two lights where they are not needed. Where there is only one light we keep it in that way.

Mr. WRIGHT: Lieut. Murdoch speaks of one of the requisites for ship installation being the settlement of the voltage. I think that difficulty is entirely overcome with the alternating current system as we can supply a converter to give you any voltage you please from our primary wire.

Lieut. MURDOCH: I am very glad Mr. Wright suggested that. I think there is one objection to the alternating current on board ship and that is for search lights. Our hand glass is rather a peculiar institution. The carbons are inclined at an angle and placed out of the line, the positive carbon being uppermost, as most of the light is given off from the end of the positive carbon in a continuous current I fear that in an alternating current system we lose this advantage. As we are trying to get a system which will use either arc or incandescent lights from the same dynamo, the alternating current in this respect does not seem so good. I do not know that I fully comprehend Dr. Moses, but in the system I speak of we work our arc lamps parallel with each other just the same as we put in an incandescent lamp.

Dr MOSES: I would state more fully then that it is desirable, of course, to run an arc lamp exactly like an incandescent lamp since the function of the arc is such that it is equivalent in a certain ratio to the constant resistance of the incandescent lamp, if you only give it time to act. The arc is a constant for every voltage, so that if you use a multiple arc arrangement and you have a 50 volt circuit, since the arc for a 50 volt lamp is best adapted for arc lighting, it is advisable to use the 50 volt circuit for that purpose, putting two lamps in series, or to throw in a considerable amount of resistance if you use a 70 volt circuit, as you suggested. There were some experiments carried on by Captain Tanner and myself on the Albatross for the purpose of using a search light. In fact, we used this arc light as a head light going around Wilmington and we found in a storm that it worked very well, but an arc light can be used on an alternating current, and if you use it for a search or signal light, the alternating current presents peculiar advantages. You have your reversals of current and you can make your flashes and signals come in with

your alternations of current. You could alternate the flashes very nicely in an alternating system.

On motion of Mr. Phelps, Lieutenant Murdoch's paper was accepted with the thanks of the association and ordered entered in the proceedings of the convention.

The resignation of President Morrison was presented and on motion was unanimously declined.

The report of the committee on by-laws was made the special order of business the first thing next morning.

Mr. DeCamp: I would like to lay before you a communication which is a matter of information. It is not information growing out of any official action of this association, but it is a matter with which you are all more or less familiar, and several questions have been asked me in reference to it. The secretary will please read it.

The secretary read as follows: "The committee of the association of electric light companies for mutual protection against exorbitant prices of carbon, after careful deliberation on the subject desire to announce that in view of the collapse of the late carbon combination and the unsettled condition of the market it is not deemed advisable at present for the association to take further action towards establishing a manufactory or the concentration of a large number of contracts for carbon, believing fully that the individual companies will experience no difficulty in placing their orders at fair and satisfactory prices.

"W. S. Freer, Secretary."

The resignation of Charles Cooper as treasurer of the association was read and accepted, after Dr. Moses had repeated to the convention Mr. Cooper's reasons for offering his resignation, viz: that the treasurer should be in the neighborhood of the president, because it often happens that the president is not aware of the deficiencies there may be in the treasury and orders are frequently given for sums greater than the condition of the treasury warrants. Therefore it is desirable that he should have at his elbow some one who can tell him the balances.

DR. WALDO'S REMARKS ON "BENDING TESTS OF LINE WIRE" AND "SILICON BRONZE WIRE."

In looking over some specimens of wire which were sent to the Baltimore & Ohio Telegraph Company, Mr. Maver and I were very much impressed with the uncertainty of the bending test of line wire. Very simple devices are oftentimes very advantageous in use, and I thought it might be of interest to tell the convention of a simple tool which will give more or less uniform results in the bending tests. The objection to taking a piece of wire in your hand and bending it, as is ordinarily done, is this: That a piece of wire bent at an angle here (illustrating) will break, not in proportion to its strength or value as a wire, but in proportion to the diameter of the wire and its crystalline structure. A very hard drawn wire, for instance, will break with much less bend around a sharp angle than around an angle of its own diameter. I noticed that in all the tests described by the division of postal telegraphs in England, Mr. Preece is careful to insist that the wire be bent around its own diameter. Any of our hard drawn coppers will break after one, two, or three bends. The little instrument which Mr. Maver and myself constructed is merely a pair of plyers, which can have pins of different sizes inserted at its center of motion and will grasp the wire uniformly. It is meant to be screwed to a board so that the angle at which the wire finally breaks on the last turn is accurately shown. I think as the mechanical properties of wire receive more and more consideration and become more and more desirable, that it is extremely important that we have a uniform system for this bending test, and I do not know of any better condition than that the wire shall be bent around its own diameter, and that the number of degrees it takes on its last turn shall be registered. For instance, we know that a wire will take three right angle bends and, we will say, fifty degrees more. You can make any simple, arbitrary device to record the number of degrees of bending that a wire will stand, and as many of our wires will break at a single bend or bend and a half it is very important that we keep the last number of degrees which the wire bends in order to have an indication of the mechanical value of these high grades and hard drawn copper conductors.

In the discussion with Mr. Preece, and also in confidence with the Lazer-Weiller people in Paris, I became a good deal interested in the silicon bronze question. I take it that we can look upon all conductors of electricity as merely transparant to electricity, so to speak, and that electricity will travel through them a good deal as light will travel through glass. [Applause.] In our dense ignorance as to the nature of electricity, of course, we can only make surmises in regard to this point, but I take it that that is a good practical conception to bear in mind. It has been found that very small quantities of alloys or the earthy metals introduced into a good conductor have very much the effect of the introduction of a small amount of iron or any discoloring influence into glass upon the transmission of light, and that has been found true particularly of some of the earthy alloys—for instance, arsenic, phosphorus and silicon. But there is also a peculiar physical change which takes place when silicon or phosphorus is added to the bronzes. What that change is I do not know, but it has seemed to me that the addition of a small amount of silicon or phosphorus must enable the atoms of molten copper to effect a certain nearer relation to each other, that is, that the centers of the atoms, so to speak, are allowed to come a little closer and that the tensile strength is much increased by the addition of these small quantities of the earthy alloys. But whatever the cause may be, it is an experimental fact that the addition of small quantities of phosphorus and silicon, and perhaps some other alloys, has given us bronzes which have high tensile strength without any greatly lessened conductivity. I began a series of experiments on silicon and its application to these bronzes to see whether we could get conductors which should have mechanical properties of a high order, and at the same time have the transparency to electricity that copper has. The first results of these experiments, after two years of work, are beginning to show themselves, and I have here a number of specimens of some silicon bronze conductors in which a high tensile strength has been obtained by using a core of silicon bronze and a covering of copper. You are all aware, perhaps, that some of the French engineers have made spans of a mile between supports in some parts of Algiers of very hard drawn pure silicon bronze wire. But the trouble with it is that the conductivity is no greater than the conductivity of steel, and in most of our purposes we want high conductivity; so I was led into a variation of the ordinary form of conductors and returned to the idea of a cored wire. It was not possible to push the construction of pure silicon bronze conductors up to a tensile strength of 120,000 pounds to the square inch, and that rivals the tensile strength of the best steel. But as a conductor for large currents that was comparatively useless, and I therefore was led into the experiment of coring the wire. I think by common consent the disadvantages of the old style of cored wire arose largely from the difference in electrical conditions between the core and its surroundings. If any moisture got between the steel core and the copper covering we had a perfect electric pile and a certain amount of disintegration would take place between the core and its surroundings. Now that difference of potential does not exist between the bronze core and the copper covering of a silicon bronze wire, because they are so nearly alike chemically and their electrical condition is almost identical. But there is another very great advantage. The fusing point of silicon—that being an alloy of copper—is slightly lower than the fusing point of copper itself, and it became possible to put in ingots of silicon bronze and to cast around these ingots pure copper. There would be a perfect joint of fusion, so that when the ingots were taken from the molds there was an ingot of silicon bronze covered with copper which would have a perfect mechanical homogeneity, and those little samples which have been passed around the room are specimens of wire drawn with a silicon bronze core with the ends polished, so that you can see there is a difference in constitution of the metal, but it is almost impossible to separate the silicon bronze core from its outside covering. This is a more or less complete solution of the problem of having electric light conductors of very considerably more tensile strength than anything which copper can give, and yet possessing almost the conductivity of copper. In the case of smaller wires the degree of success attained is equivalent to about the following figures: A wire 103–1000 of an inch in diameter will break at about 650 pounds, and for tension and bending it is much more satisfactory than the best hard drawn coppers which we have been able to get You have, too, variable quantities of conductivity and tensile strength, and you can save either at the expense of the other; so that it becomes possible by using the silicon bronzes to vary for particular conditions either of those qualities. I think the experiments which we have made bid fair to be successful in producing permanently a conductor—not perhaps better than copper, because we purify our copper more and more, and the present conductors of copper will undoubtedly be increased—but a conductor which is very good and which will possess mechanical properties which thus far have not been available.

One thing more as to the ultimate course of experimenting in this direction. The silicon-bronzes made in Europe have been expensive because of the prohibitory prices put on by the owners of the only patents under which they could be made—the Lazar-Weiler patents—but owing to the genius of the Cowles in the working of their smelting furnaces, by which silicon can be reduced from its quartz in a much less expensive way than any other that has yet been tried, and in consequence of the low price of silicon, these silicon bronzes will be made, doubtless, at a cost which will not at all be prohibitory for their use in places where wires happen to be swung from supports and tensile strength becomes of great value.

Dr. Moses: The very interesting remarks of Dr. Waldo have elicited from my neighbors here a comment which I would like to bring to the attention of the convention. He suggests that perhaps the hard drawn core being more slowly acted upon by its own weight in stretching, would perhaps break after the outer covering had yielded. Experiments on tensile strength are conducted so rapidly that there is no opportunity that I see for fatigue of metals becoming a factor. It recalls to my mind a remark that was made to me by one of the engineers of the Brooklyn bridge. He said that he was anxious to find out what the effect would be of the introduction of quite a number of what are called hard wires into the cables of the Brooklyn suspension bridge. It appeared that some dishonest contractor had given, strange to say, a better wire than he was called upon to give, that is, a hard wire instead of a soft one; but it had come in the course of his manufacture and he had thrown it into the lot of wire forwarded. In the tensile strength experiments made, it was found to be unsuitable to the bridge, but still he found a means of getting it in. I believe the man is suffering to-day for it in one of the penitentiaries. The conditions were similar to those spoken of by Dr. Waldo, though not exactly the same. The hard wires are supposed to be in the condition, that yielding less than the soft wires, the ultimate strain will be drawn upon by the fatigue of the metal in the course of years, so that these wires are, practically speaking, getting the whole strain upon them. I mention that, so that in conducting further experiments, if you can introduce time into the experiments so as to see the effects of fatigue on the copper covering, it will be a very interesting thing.

Dr. Waldo: I think the whole question of the mechanical testing of wire is one of extreme importance. I have been very much struck in testing long series of wires with the disturbance caused by this very fatigue of the metal of which Dr. Moses speaks. In using a testing machine for testing strengths, it is of the utmost importance that the strain be applied very gradually, because you could all get different results in a machine where the strain is applied gradually at an interval of several minutes we will say, for each wire and where the strain is applied rapidly. I, for one, would like to see a committee or some representative body which should take under consideration the unification of the mechanical tests for wire for electrical purposes. I think the bending and the torsion and the breaking tests are all now made very much as a particular whim of the company or person using the wire prescribes, and if we had a uniform method of making these tests we should have data for preparing conductors mechanically in a way which is not now possible. I do not know but that I am ready to make a suggestion that a committee be appointed having for its province the consideration, for report at some future meeting of the convention, the best means of establishing a uniform system for the mechanical testing of wire for electrical purposes.

Dr. Moses: I think that is a very excellent suggestion, and I hope that the president, in appointing that committee, will consider the extent of the investigations of Dr. Waldo by referring the matter to him as one of the members of the committee. There is, I think, a committee appointed for the purpose of considering insulations and wires in general. But this might be made a special subject of investigation, and if it is the pleasure of the convention to appoint such a committee, I hope Dr. Waldo will take charge of it.

Mr. Mailloux: In regard to the conductivity of copper, of course, it is important to use the specific resistance of the copper, and I would like to ask Dr. Waldo a question particularly directed to finding out whether electrolytically produced copper has ever been used in making wires I have had considerable experience in making copper by electro-deposition, and I found it is possible to make a copper which is not only very pure—sometimes 999 fine, but it is also a very ductile substance, and it can be bent a large number of times without showing an absolute rupture; it seems to draw out in bending, so that the broken ends look very much like an electric light carbon, for instance, and it occurred to me that perhaps some attention should be given by wire makers to the use of that kind of copper.

Dr. Waldo: I confined our experiments at first to copper which was electrically deposited on the cores and we obtained some remarkably fine specimens of wire in that way, but the cost of the process was prohibitory. The copper which I have used frequently is merely the highest grade of Lake Superior copper.

Mr. Mailloux: Referring to electrolytically deposited copper, I did not mean that it was deposited on a core by electricity, but I referred rather to copper which has been produced in the form of slabs by means of electric deposition. There is now a firm in New York that has produced, I understand, some five hundred tons of plates of copper per month by means of electrolysis, and I meant particularly copper which can be used in ingots just like any other form except that it is very pure and exceedingly ductile.

Dr. Waldo: There is great danger in the melting of copper. One of the most insidious difficulties in the manufacture of high grade conductors is the introduction of a sub-oxide and a protoxide of copper as an impurity. I am very much afraid of any process which involves the constant melting or remelting, and I should be afraid that electrolytically deposited copper would lose all it would gain by being electrolytically deposited in any ordinary process of melting. The protection of that copper during melting has been one of the most serious difficulties that we have had to face.

Dr. Moses: In the refining of copper, the solution of protoxide of copper in the copper itself is one of the difficulties in the way of getting a pure copper by ordinary smelting processes, because it seems to disseminate itself so thoroughly in the mass of copper. In electrolytically deposited copper that is not the case, but there are other objections, and I wish they could be brought before the convention.

Dr. Waldo's suggestion that a committee be appointed to establish a uniform system for mechanically testing wire for electrical purposes was accepted, and the chairman announced that he would add the committee to that to be appointed by the president on the "Proper Insulation of Wire and Installation and Construction of Plants."

The convention adjourned until Thursday morning at 10 o'clock.

THURSDAY MORNING'S SESSION.

The report of the committee on "Revision of the Constitution" was the first subject taken up Thursday forenoon. After some discussion the constitution as reported by the committee was adopted with some few modifications. The following is the

NEW CONSTITUTION:

I. The name of this association shall be "The National Electric Light Association."

II. Members of this association shall be companies, firms, or persons, operating electric light and power stations for public or commercial purposes, manufacturers of electrical supplies and apparatus. Electricians, electrical engineers and persons, firms or companies whose professions or business is directly collateral thereto, may become members, upon the recommendation of the executive committee and approved of by the association.

Each member, in a vote by ballot, shall be entitled to one vote.

A ballot may be demanded by one-fourth of the members present.

Persons may become honorary members, without the right to vote by ballot, of the association.

III. The officers of this association shall be a president, two vice-presidents, treasurer and secretary, and an executive committee of six members, the president, vice-presidents, treasurer and secretary being members *ex officio*.

IV. The president and vice presidents shall be elected by ballot to serve from the close of the annual meeting at which they are elected until the close of the next annual meeting.

V. The treasurer and secretary, who may be one and the same person, shall be nominated by the president subject to the approval of the executive committee. The executive committee shall be chosen by ballot at each meeting, either annual, semi-annual or special, to hold office

from the close of the meeting at which they are elected until the end of the meeting at which their successors are chosen.

The duties of the several officers shall be those usually pertaining to their respective offices.

The treasurer, secretary and executive committee shall make a written report at each meeting to be spread upon the records of the association.

VI. The executive committee shall be the governing body of the association, three of which shall constitute a quorum. They shall meet from time to time and shall report upon application for membership, gather and prepare information upon topics of interest and arrange for their discussion at the several meetings of the association.

VII. The annual meeting of the association shall be held in February, and the semi-annual in August of each year at such place as the association shall determine, and such date as may be determined by the executive committee.

VIII. The membership fee of each member shall be $10—which shall accompany the application.

The annual dues shall be $10—payable in advance and shall cover the calendar year.

IX. All amendments to the constitution shall be presented in writing and referred to a committee to be appointed by the chair before being acted upon by the association; a two-thirds vote of those present shall be necessary to their adoption.

A ballot on such amendment may be called for upon the request of five members of the association.

As reported by the committee, the fourth section contained the following clause: "The same person shall not be eligible to the office of president and vice-president for two successive terms. The striking out of this clause, on motion of Dr. Moses, was the only material change made in the constitution as proposed by the committee.

C. B. DE LA VERGNE, of Boston, proposed an amendment, making ineligible to appointment on committees persons interested in the subject matter of such committee investigations through a pecuniary interest in an article which the committee's report would affect, and also providing that no person should be appointed on a committee to report on an article or commodity who had not some familiarity or practical experience in the use of the article or commodity which was to be the subject of the committee's report. The amendment, after some discussion, was rejected, the reasons against it appearing to be that it was incapable of being practically carried out, that the best committee work would be done, as it had been done in the past, by persons directly interested in the subject matter of that particular committee's investigations, and that any attempt on the part of one member of a committee to intrude too much of his own personal interests in the work would be promptly checked by other members.

Members will be furnished copies of the new constitution by the secretary.

The report of the committee on "Wire Gauge," which had been made a special order of business, was then taken up, and Mr. Phelps presented the following:

"*Resolved*, that the report of the committee on wire gauge be received and the committee discharged with the hearty thanks of the association for the valuable work accomplished by them and presented in their table of the mathematical properties of the metric gauge; and it is further

"*Resolved*, that in view of the large number of gauges already in existence and the confusion arising in their use, it would, in the judgment of the National Electric Light Association, be inexpedient to promulgate an additional gauge. The association earnestly recommends to its members and all others using copper wire the practice of designating sizes by definite diameters, such practice having already gone into extensive use, as a feasible escape from the confusion of many gauges. The association further recommends the use of the meter and its fractions in designating diameters, and in furtherance of that end publishes the tables presented by its wire gauge committee August 9th."

Mr. MASON: When I made the motion to make this the order of the day it was in view of a resolution like the following which I will beg leave to submit as a substitute for the other:

"*Resolved*, that the report of the wire gauge committee be accepted; it being understood that by accepting it, we, as an association, commit ourselves to the following: First, that in reports, communications, etc., we will designate wires by their diameters expressed in fractions of the meter; secondly, that in our personal conversation and business we will designate wires in the same way in so far as we find possible; thirdly, that this association offer to wire manufacturers such aid in the way of information as shall enable them intelligently to list their wires on the metric system."

Now, Mr. President, my point is this: If a man wants a gauge, we have a gauge there in the table which has been presented to us. I beg leave to differ a little from the chairman of the committee on that point. The left-hand column of figures upon the table which is before the convention contains arbitrary numbers, although they are based upon the second column—the tenth of a millimeter—but we have there a gauge and those numbers will undoubtedly, if such resolutions be passed, come into use by us. We can telegraph for wires under these numbers. I am very confident that the majority of the association feel that while we do not wish to go any further than is necessary in this matter, we want to do something that will commend itself to the users of wire and the makers of wire throughout the country. It seems to me that we are only following in the line of action taken by our government and taking a very modest step if we shall adopt the resolutions just read.

Mr. GARRATT: I understand you, Mr. Mason, that that would not, of necessity, oblige us to do anything only as we found it convenient in our business.

Mr. MASON: I understood, Mr. President, that a letter was read six months ago in our session from Messrs. Brown & Sharpe, in which they stated that they regarded the proposed metric gauge as very superior to their own and if this convention would in some way adopt it or express its approval of it they would be very glad to adopt it for use in the measurement of their wires. That was a very strong testimonial to the value of this proposed system and I would like some action taken which would lead them to do that which they proposed to the association. Other wire manufacturers will probably follow in the same line, and I feel that we shall all be greatly convenienced. I received an order a short time ago for a number of miles of wire from the far west. The order simply read so much number 8, so much number 10 and so much number 12. I sent them the Brown & Sharpe gauge. They were to a certain extent useless out there. The gentlemen ordering used the Birmingham gauge. If it is understood that this association has, in a general sort of way even, adopted this metric system, we shall have our orders and know what they mean.

MR. GARRATT: I would vote strenuously against any adoption of any system of wire measuring which should, in a cast iron way, commit us to it. I would not vote for the adoption of any system of measuring wire which would not leave each individual completely at liberty to do whatever he wished to do. If a man can not find it more to his advantage to use this system of measuring than any other, we never can oblige him to do so, and I would personally decline to commit myself to it. My idea in regard to that would be this: Take such action as would leave us at liberty, with the commendation and encouragement of the association, to use a better system of measuring than we heretofore have had, the best I know of being the application to the wire of its simplest principle, namely, its diameter.

Mr. MAILLOUX: Perhaps I permitted myself to say too much in the previous discussion, and I may have been construed to mean that I disapproved of the work done by your committee. I think it is doing justice to myself and to the committee to say that I am heartily in sympathy with the work. I believe I took especial care to express my appreciation of the precision and care with which the work has been done. I agree perfectly with the sentiments just expressed by Mr. Garratt. I regard the valuable work done by them as a priceless contribution to the fund of knowledge which we have regarding the methods by which we measure the various properties of wire. At the same time I am aware, as you all are aware, that in this country the inch is used very extensively. Since the discussion Tuesday I have taken the opportunity to speak of the matter with several makers of electrical machinery who are using wire in very large quantities, and they have told me that so far as they were concerned they could only make use of this gauge to a very limited extent—that they would adhere to the method of determining sizes by the thousandths of an inch, because, as they use the foot as the unit of length, it would be very inconvenient to determine the area of sections of conductors in one system of measurement and the length of it in another system of measurement: so that in making computation as to the space occupied by the wire or as to the weight of the wire, they would find themselves in a worse predicament than they were before. I also noticed that in wires of certain applications the thousandth of an inch is more convenient than the other. I believe that, while the system proposed by the committee is very valuable and undoubtedly has a great range of application, we ought not to force people to accept it, because if one system is more applicable than another, the person who finds it of greatest convenience to use that system ought to have the privilege of using it. Consequently, I oppose the motion.

Mr. EUSTIS: In regard to that computation of weight which the gentlemen was speaking of—changing from millimeters into feet, that is, measuring the diameter in millimeters and yet computing the weight for a given length in feet—I think if he had studied the table as much as I have, perhaps he would have found it easy to make the calculation from the number which is given as the logarithm of the sectional area, and then by simply multiplying that one number by a constant he could get the pounds per thousand feet which is given here. It is immaterial in any computation of this sort, whether you start with an inch or with a millimeter in making the final determination. The constant holds true; because your length, your weight per thousand feet, is proportional to the sectional area multiplied by some given constant, whether you take the sectional area in inches or whether you base it on millimeters is immaterial. I have here the constant for the calculation of pounds per thousand feet. I will just put that on the board in case anybody would like to have it (illustrating). That is the constant which is to be subtracted from the logarithm of the area given in square millimeters.

Mr. MAILLOUX: It has happened with me several times that I had to make calculations that very way. I am perfectly aware that it can be done, but I was merely referring to the confusion that is likely to arise where you are accustomed to calculate volume by one method. You are quite likely, especially where there are numerous calculations to be made, to forget the constant. I have been obliged recently to make a great deal of use of the metric system in calculation, because I had to design apparatus with reference to plans sent over to me from abroad, which were made on metric system. In a case like that I find it very convenient indeed, but where it is necessary to pass from one to another I have found in several instances that you are likely to be confused by forgetting the constant.

Mr EUSTIS: As the gentleman has spoken about mislaying his constant, I would simply ask him how he obtained a constant for the determination of the weight per thousand feet, where the diameter is given in inches. If he has to determine that every time separately, why is it not as easy to determine that in the metric system as in feet and inches?

Mr. MAILLOUX: I mean the constant of converting the length of the wire into meters or fractions.

Mr. STEUART: This opposition to the motion, as it now lies before the house, reminds me very much of a "bugaboo." It is an imaginary evil that may come and may never come. The question of whether this gauge would be useful is altogether a question of the survival of the fittest. The question which presents itself practically is whether this thing will prove to be so much better that every one will adopt it in preference to inches, and I think that is the only question which is to be determined, and that can only be determined by practical tests in actual use, and I think that the opposition to the passage of this motion, which is merely a suggestion on the part of this association, is altogether out of place.

Mr. WHEELER: Mr. Mason's resolution is so strongly worded in regard to this association committing itself to certain things that I think we want to be very sure, before we do commit ourselves, that the gauge proposed is a good one. All the gauges that have grown up by reason of the needs of wire makers have had the notches made so that the larger sizes differed by larger spaces than the smaller sizes. That is very well shown by the charts prepared by the committee on wire gauges, where the numbers are placed so as to correspond with the old gauges, and the first number equals number 38 of the ordinary gauge and the second number equals number 32; therefore the gauges we have been using for the fine wire sizes have six numbers in between the first two of the new proposed gauge, and at about the bottom of the chart, at about number 00 of the old gauges, there are nine numbers of the new gauge which correspond to the one number 00 of the old, which shows that in the fine numbers the new gauge does not have fine enough differences, and at the bottom the new gauge has too fine spaces; that is to say, take a number 38 wire, for instance, which differs from number 37 by half a thousandth of an inch, and in the new gauge the difference is six times that, which is not fine enough for practical work. We are sure to need some number between number 1 and number 2 of the new gauge, and at the bottom we have one number of the old gauge which covers nine numbers of the new. I think, therefore, that the best thing in view of the fact that we have now twenty-five or thirty gauges in use, is to pick out some one which is the best that we can find and not create a new gauge.

Mr. GARRATT: Before two conventions I have debated and explained at length the objection raised by the gentleman. He will find it in the electrical and in a number of the daily newspapers. I have suggested no gauge. That is simply a table by which from the tenth or the hundredth of a millimeter you can determine the property of any wire you wish. Again, the gentleman says let us pick out a gauge from the existing gauges. Of the present existing gauges there are fourteen Birmingham gauges in use to my knowledge, and there are thirty or forty Brown & Sharpe gauges used in America. The question of there being in the small numbers too great variation has been replied to and replied to until I am sick and tired of it. Any mathematician who knows the rule of three can construct from any one of those small numbers the properties, electrical and physical, which he requires. In ordering wire he can order by the hundredth of a millimeter, and he can determine that by the micrometer. The statement that those numbers do not correspond to the Brown & Sharpe ratio is entirely impertinent to the question. I repeat that I have advanced no gauge.

Mr. Mason's substitute motion was lost and Mr. Phelps resolution was carried.

A motion to adjourn at five o'clock this afternoon was carried.

The treasurer was directed to draw upon the funds of the association for $50 to meet the expenses of the attendance of the secretary at the convention, and a bill for $60 for printing a paper, presented by Mr. DeCamp, was ordered paid.

THURSDAY AFTERNOON'S SESSION.

The convention was called to order at 2:30 P. M.

On motion of Mr. Leggett the undergrounding of wires was made a subject for discussiou after the reading of the papers announced on the programme.

Mr. MAILLOUX then read

THE PRESENT STATUS OF THE STORAGE BATTERY.

In one of his masterly newspaper interviews a well-known American electrician once said of the storage battery that it was chiefly remarkable for its power of stimulating the propensity for lying which is inherent in some natures. This sweeping assertion naturally makes me realize very fully the possible risk of compromising my reputation, which I run in undertaking to make a few observations relative to the storage battery.

Under the circumstances an apology might seem to you to be a suitable preface, but I trust that a simple explanation will suffice to dispel all doubts on your part as to my good faith in the premises. This explanation rests upon the fact that the storage battery, like the dynamo, the arc lamp, the incandescent lamp, and many another thing, has grown and progressed. Only a year ago I would have hesitated, perhaps refused, to say anything before you in favor of the storage battery. My reason would not have been a lack of confidence, but rather a feeling that the era of the storage battery was not yet at hand. I felt that this youthful offspring of the great and powerful family of electrical applications promised to play as important an industrial role as any of its colleagues, but I also knew that it had already made one debut some years ago and failed to draw, because it was too young. I would have been sorry to see its chances of success forever spoiled by a second premature attempt. The child seems, however, to have now had sufficient time to mature and perfect its training, and after an interval of some five years it has reappeared upon the scene, this time with a fair and encouraging success. Within a few months there has been in America a great revival of interest in the storage battery, as you are aware. Many of us practical men, who were once disposed to be skeptical, begin to regain confidence. Certainly, the applications which have been made of the storage battery in this brief period prove beyond dispute that this time the storage battery

is coming to stay. In some cases it found a new and profitable field waiting for it, as for instance in railroad car-lighting. In many other cases it opened an entirely new range of possibilities by its playing a secondary role. In a word it has a wide sphere of usefulness to cover, through many devious paths, some of which it alone can tread over, and many of which it will compass with the help of other applications of electricity. It does not presume to fill all these parts at once. In the case of some of them it may prove wise to permit the process of evolution to go on for some time to come before they are considered.

It is not necessary, however, for the storage battery to wait until it can accomplish everything before accomplishing something. There are many applications where it is now entirely competent to give satisfactory results, and while doing what it is at present capable of, it can learn what it does not know. The dynamo was not at first what it is now, nor was the lamp, nor indeed the details of lighting systems. Electric lighting was limited at first to isolated installations. The range of adaptability, compared with what it now is, was limited greatly. It was necessary to confine the applications of the light to isolated cases of fitness, since the apparatus was too limited in every respect to admit of doing more. But while we were doing what lighting could be done with these facilities,— and making money too, even then,— we were learning to do more. Invention, and the yet greater force evolution, were hard at work to give us better ideas and more practical devices. In time came the central station, such as it was,— and I might emphasize the *such*. Many are here present, doubtless, who were operating these pioneer arc light stations, with long rows of dummy lamps, to be shifted in or out of circuit for the purpose of balancing the work in the circuit itself. Then came the current regulator, and following in its wake succession of devices and improvements, of methods, of systems. The evolution of the incandescent light is also of equal interest, and from the useless platinum wire lamp to the very useful alternating system of to-day, the steps are so numerous and strange that the mind finds itself in a regular museum in attempting to retrace them. I need not tell you that the evolution of the electric light is not complete. The very existence of our organization proves that, since our object is to promote and further the process of development. Each year we have found electric lighting advancing a few steps. Ten years from to-day we may have made so many of these steps that our present systems may seem obsolete, yet these very systems in their time were good enough to earn dividends with. This is precisely the case of the storage battery. Its application can even now play a brilliant part in electric lighting, but it can be very useful even if intrusted with a more modest part. In a word, it has arrived at that age and condition of development which fit it to enter the actual service of civilization and begin the race for promotion. If I may judge by the very favorable attention which the storage battery has received from the public and particularly from those who are dispensing electricity to the public, I think I can venture like our very genial friend and learned colleague, Dr. O. A. Moses, to prophesy that the storage battery is going to be the next great step of progress. It has already taken its place in line, and I believe it will speak for itself inside of a year.

With regard to the storage battery itself, it may be said that in following its development since the days of Plante, one meets with an already large and interesting collection of ideas and devices. It is outside of the scope of the present paper to enter into the study of the steps by which the art has arrived at the present stage. The number of patents relating to storage batteries in this country and in Europe is already quite large, nevertheless the number of good storage batteries is exceedingly small. In this respect history repeats itself. The large and constantly increasing number of patents on dynamos, lamps, regulators, converters and what not, when contrasted with the small number of those inventions which are really useful, suggests that a large proportion of inventors must have been engaged too deeply in taking out patents, and pay altogether too little attention to the work of reducing their inventions to practice. Passing by the history of the secondary battery and the theories of its action, which properly have no place in a paper like this, it might be of interest to dwell briefly on the objections urged against the storage battery. The two chief objections are, limited life or durability and low economy. I shall frankly admit at the start that in many cases these objections are sufficiently valid to throw the storage battery out of competition. The final commercial test of the storage battery, however, is the prospect of gain which it offers, under the circumstance of any given case. Viewed in this light the above objections to the storage battery lose some of their force. I can cite as an example the case of a Philadelphia hotel which it is proposed to light by electricity. A practical electric light man who has been engaged in the business of establishing and operating central station plants ever since the beginning of electric lighting, went over the case very carefully and came to the conclusion that the storage battery would be preferable. So well satisfied is he of the fitness of the storage battery that he submitted detailed propositions for furnishing light. The present cost of lighting the hotel by gas is $7,500 per annum. For the sum of $6,500 per annum, this practical man is willing to assume the responsibility of furnishing light for a term of years. Being a careful and shrewd business man he has made a wide allowance in his calculation. He does not count upon the two years guaranteed life of the battery plates, but assumes a necessity for their entire renewal in one year. He calculates nevertheless to make 15 per cent. on his investment, and I may say that he seldom makes mistakes in his ventures. In this case, the fact that light must be on "tap" for every moment of the 24 hours, becomes an important consideration, and the evident advantages of the storage battery outweigh the questions of durability and economy. Now, taking up the question of durability by itself, I may say that it is greatly dependent, not only upon the kind of battery, but even upon the use to which it is put.

Then perhaps he may neglect to put in more than the quantity necessary for a normal capacity. The result is that the battery is not fully charged, and to furnish the usual capacity it must be discharged by drawing upon its residual charge. He soon finds his battery giving symptoms of disease, and in a short time both the positive and negative plates will require doctoring, instead of one kind only.

It must be said, however, that improper care is not solely responsible for all the trouble that affect the life of the storage battery. Some difficulties, like the scaling off of the active matter, the buckling and stretching of plates, are largely inherent in the battery. They are natural consequences of the manner or method of making the battery. So it may be said that here the storage battery has a personal equation depending on the make, the care, skill and knowledge of the maker. This amounts to saying that some kinds of storage battery are more troublesome to keep in order than others.

The life of the storage battery plate must not be regarded as doomed to remain compassed within the term of a couple or three years. The limit is gradually being extended, and it may be said that each succeeding batch of the product of a factory is slightly better than the preceding. The same may be said of the cost, which of course is an important consideration, in view of the necessity for repairs or perhaps removals at certain intervals. The cost of manufacture has been reduced thirty per cent. inside of one year, and it is even expected that it will be brought down to fifty per cent. before the year is up. The prices have not been reduced because the demand is great even as it is. This of itself shows that the storage battery has already a good field of usefulness where it can command to a great extent its own price.

The weight of the battery is another of the objections to be met, particularly for street cars, etc. This objection is one which is of particular rather than of general application. It depends on the battery. We know however, practically, that with 27 lbs. of active matter, it is possible to provide a supply of energy for 6 lamp-hours, or over 10 watt less per lb. of matter. This result will no doubt be improved upon greatly.

Last but not least among the objections used against the storage battery is that of reduced economy. My esteemed friend and colleague, Mr. Anthony Reckenzaun, whom you will have the honor of hearing after me, will give you very clear and precise information on this question of economy, more practically as regards the use of storage batteries for power. I will leave this portion of the subject to him because I know he is a most competent authority. I will permit myself also to commend his very intelligent work in Europe during the last five years, in the application of accumulators to electrical traction and propulsion.

The question of economy considered in relation to the storage battery does not present such difficulties as might at first be supposed. Considered as an apparatus for transforming energy for electric lighting by incandescence, the storage battery has an efficiency so much below that of the dynamo, or the transformer, that it cannot hope to enter into direct competition with these in many cases. Of the electrical energy produced by the charging dynamo, probably not more than 65 to 70 per cent. finds its way into the lamps. With direct lighting, as we know, we may obtain as much as 90 per cent. But just here there is a question of great interest and importance which arises, namely: the proportion of energy appearing in the lamp as light. In an incandescent lamp probably not five per cent. of the energy expended is utilized as light. This five per cent. of rays represents the proportion of heat rays which are visible. The other rays are invisible. Now it is also well known that this very proportion of the useful light-giving heat increases with the absolute temperature of the filament. This means that the higher we raise the incandescence of the filament, the more light it gives for a given amount of electrical energy. But when the filament is brought to an excessive temperature its life is not so great. Just here I will note the fact stated by authorities that alternating currents have been found to increase the life of the filament as compared with continuous current. Now I can supplement this with the statement that the storage battery current gives yet much longer life to the lamp. It permits the raising of the filament to a higher degree of temperature, and consequently it leads to a gain in the energy required.

We have found in practice that we can obtain the same average life of 600 hours with a lamp of 2½ watts per candle power, while direct currents would require lamps of 3½ to 4 watts per c. p. In our early work, realizing the great disadvantage at which we are placed, we resorted to the use of lamps of higher economy, so called. The makers of these lamps refused absolutely to give any kind of life guarantee. They were themselves yet more surprised than we to learn of the remarkably long endurance of these lamps, even on board cars, where the filament is subjected to the wearing effect of mechanical vibration.

Of course I can not pretend to say what is the cause of this increased life of lamps with the storage battery current. It is probably related in some manner to the fact that the current of a storage battery is continuous in the strict sense of the term, while the current of dynamos and transformers are wavy in character.

It would seem therefore that so far as electric lighting by incandescence is concerned, while the storage battery is opened to the objection of wasting at the spigot, it can claim some saving at the bung-hole, which quite nearly equalizes the difference between the results obtained by the direct and storage method. Taking our 65 per cent of energy, or in round numbers 485 watts, we can obtain twelve lights per electrical horse power of 746 watts produced in the dynamo, using lamps of 51 watts, which is the most economical yet heard of with a continuous current, we have the following results: Out of 746 watts, taking 90 per cent as available at the lamps, which is a liberal proportion, we have 671 watts or less than twelve lamps, or less than 12 lamps of 51 watts. If we consider the fact that in practice, lamps of 60 to 70 watts per 16 candle power are the rule, the difference would be yet greater in favor of the storage battery. Taking another view of the question we can calculate what is the lowest per cent of efficiency permissible in the storage battery.

Taking 11 lamps as the result of the direct application from the dynamo, we find that the storage battery must, at 40 watts per lamp, supply 440 watt hours out of each 746 watt hours given to it, or somewhat less than 59 per cent.

I need not dwell at length upon the uses of the storage battery and the services which it can render in connection with electric light plants, for these are quite generally understood, and new ones suggest themselves all the time. The present rate of demand shows that the uses are at least equal to the rate of supply and sometimes in excess. One application of special interest in this connection, however, is that in connection with incandescent lighting, both from isolated and central station plants, the incandescent light is growing in favor so rapidly that where it is already in use for a certain number of hours during the evening, there is an objection to the use of gas at other times. In small installations it would not evidently pay to run constantly for a few lights. The storage battery would here be very useful, if not indispensable, and a number of local companies who could sell electricity for power in limited amount are also turning to the storage battery, since they are compelled to run during the day to supply electricity for a few lamps and motors, they find it would be as well to run to full capacity, using the balance of power to charge storage batteries from which the energy can be drawn later in the evening, to supply incandescent lamps.

In conclusion, I hope I have succeeded in making a fair presentation of the storage battery case, so far as it concerns the uses and purposes of electric light men. As I have intimated, the storage battery is as far from being perfect as were the first dynamos with which some of the enterprising men of this very body first paved the way to the great industry that now interests so many minds and enlists so much capital. But it is so far perfect, however, that it is ready to help enlarge this great industry to push further ahead in its wonderful development.

At the close of the reading of Mr. Mailloux's paper, a call was made for Professor Reckenzaun's paper on a kindred subject.

Professor Reckenzaun then read his paper on

STORAGE BATTERIES FOR ELECTRIC LOCOMOTION.

The idea of employing secondary batteries for propelling vehicles is almost contemporaneous with the discovery of this method of storing energy. To Mr. Planté, more than to any other investigator, much of our knowledge in this branch of electrical science is due. He was the first to take advantage of the action of secondary currents in voltaic batteries. Planté is a scientist of the first grade, and he is a wonderfully exact experimenter. He examined the whole question of polarization of electrodes, using all kinds of metal as electrodes and many different liquids as electrolytes, and during his endless researches he found that the greatest useful effect was produced when dilute sulphuric acid was electrolyzed between electrodes of metallic lead.

A set of Planté original cells was exhibited for the first time, in March, 1860, before the Paris Academy of Sciences; scientists admired and praised it, but the general public knew nothing of the great discovery thus brought to notice. Indeed, at that period little commercial value could be attached to such apparatus, since the accumulator had to be charged by means of primary batteries, and it was then well known that electrical energy, when produced by chemical means in voltaic cells, was far too expensive for any purpose outside the physical laboratory or the telegraph office.

It was twenty years after this exhibition at the Academy of Sciences in Paris, that public attention was drawn to the importance of storage batteries, and that Mr. Faure conceived the idea of constructing plates consisting of lead and oxides of lead. At that time the advantage accruing through a system of electrical storage could be fully appreciated, since electrical energy was already being produced by mechanical means through the medium of dynamo electric machines.

It was the dynamo machine which created the demand for the storage battery, and the latter was introduced anew to the public at large and to the capitalist with great pomp and enthusiasm. One of Faure's accumulators was sent to Sir William Thompson, and this eminent scientist in the course of experiments ascertained that a single cell, weighing 165 lbs. can store two million foot-pounds of energy, or one horse-power for one hour, and that the loss of energy in charging did not exceed 15 per cent. These results appeared highly encouraging, there we had a method of storing that could give out the greater part of the energy put in. The immense development which the electric transmission of energy was even at that early day expected to undergo pointed to the fact, that a convenient method of receiving large quantities of transmitted energy, and of holding it in readiness until wanted, must be of the highest importance. Numerous applications of the Faure battery were at once suggested, and the public jumped to the conclusion that a thing for which so many uses could be instantly found must necessarily be a profitable investment, and plenty of money was provided forthwith, not with the idea of commencing careful experiments, and developing the then crude inven-

tion, which would have been the correct thing, but for manufacturing tons of accumulators in their first and immature form.

I need not describe the disappointments which followed the first unfulfilled hopes, nor repeat the criticism that was heaped upon the heads of the early promotors. Those early hopes were untimely and unreasonable. A thousand difficulties had to be overcome,—scientific difficulties and manufacturing difficulties. This invention, like most others, had to go through steady historical developments and evolution, and follow the recognized laws of nature which are against abnormal and instantaneous maturity. The period of maturity has also been retarded by injudicious treatment, but the ultimate success was inevitable. Great advances have been made within the last few years, and I propose now to offer a few facts and figures relating to the present state of the subject with reference to the application of storage batteries to locomotive purposes. It is not within the province of this paper to discuss all the different inventions of secondary batteries nor to offer any suggestions with regard to priority, therefore I will confine myself to general statements. I am aware of the good work that was done in the United States by Kirchoff, twenty-six years ago, and of the more recent work of Mr. Brush, of Cleveland, Mr. Julien and others, but I am more particularly acquainted with the achievements of the New York Accumulator company, who own the rights of the Electrical Power Storage company, of London. I have used the batteries of the latter company for propelling electric boats and electric steam cars. The first of the boats was the "Electricity," which was launched in September, 1882, and which attained a speed of seven miles an hour for six consecutive hours. Since then a dozen electric boats of various sizes have been fitted up and worked successfully by means of storage batteries and motors of my design. The most important of these were the launch "Volta," and another similar craft, which is used by the Italian government for torpedo work in the harbor of Spezzia. In the measured mile trial trips the Italian launch gave an average speed of 8.43 miles an hour with and against the tide. The hull of this vessel was built by Messrs. Yarrow & Co., and the motors were manufactured by Messrs. Stephens, Smith & Co., of London. The "Volta," which was entirely fitted by the latter firm, is 37 feet long and 7 feet beam, she draws 2 ft. 6 in. of water when carrying forty persons, for whom there is ample sitting accommodation. There are sixty-four cells in this boat, these are placed as ballast under the floor, and actuate a pair of motors and a screw coupled direct to the armature shaft running at 700 revolutions a minute. We crossed the English channel with this boat in September last year, leaving Dover at 2:40 in the morning, arrived at Calais at 2:30 P. M., stayed about an hour in the French harbor for luncheon, and floated into Dover docks the same evening at 6:30, at full speed. The actual distance traversed without entirely discharging the cells was fifty-four miles, the current remained constant at 28 ampères until 5 P. M., and it only dropped to 25 ampères at the completion of the double voyage between England and France. Several electric launches are now being constructed in London, and one in New York by the Electric Accumulator company.

M. Trouvé exhibited a small boat and a tricycle, both worked by Planté accumulators, at Paris, in 1881.

The first locomotive actuated by storage batteries was used at a bleaching works in France in 1882. During the same year I designed an electric street car for the Storage company, and this was tried on the lines of the West Metropolitan Tramways in March, 1883. It had accommodation for 46 passengers. This car had many defects, and I reconstructed it entirely, and ran it afterwards in its improved form on the South London tramways, and also on a private track at Millwall, where it is now in good condition, and have a similar car in Berlin. M. Phillippart exhibited a car in Paris and M. Julien made successful experiments in Brussels, Antwerp and Hamburg. Mr. Elieson is running storage battery locomotives in London. Mr. Julien has also been experimenting with a car in New York, and I believe one is in course of construction for a line in the city of Boston. Messrs. W. Wharton, jr. & Co. have a storage battery car running at Philadelphia on Spruce and Pine streets, and this energetic firm is now fitting up another car with two trucks, each carrying an independent motor, similar to my European cars.

I have mentioned all these facts in order to show tha there is a considerable amount of activity displayed in the matter of storage batteries for street cars, and that continued and substantial progress is being made in each successive case. The prejudices against the application of secondary batteries are being rapidly dispelled, and there are indications everywhere that this method of propulsion will soon take a recognized place among the great transit facilities in the United States. I feel convinced that this country will also in this respect be far ahead of Europe before another year has passed over our heads.

There are several popular, and I may say, serious objections to the employment of storage batteries for propelling street cars; these objections I will now enumerate and endeavor to show how far they are true, and in what measure they interfere with the economical side of the question.

First objection: The loss of energy, which amounts in practice to 20, and sometimes 30 per cent. Now, every method of storing or transmitting energy involves some waste, but in saying this we need not condemn the system, for after all the term efficiency is only a relative one. For instance, a 10 horse power steam engine consumes three times as much fuel per horse power hour as a 1,000 horse power engine does, yet this small engine must be, and is regarded as one of the most economical labor saving appliances known to us. Considered as a heat engine the efficiency of the most economical steam motor is but 10 per cent.—90 per cent. of the available units of heat contained in coal being lost during its transformation into mechanical energy. Thus if we find that the storage battery does not return more than 70 per cent. of the work expended in charging it, we ought not to condemn it on that account until we have ascertained whether this efficiency renders the system unfit for any or all commercial purposes. It is needless to go into figures in order to show that, when compared with animal power, this objection drops into insignificance.

The second, more formidable objection, relates to the weight of storage batteries—and this involves two disadvantages, viz.—waste of power in propelling the accumulator along with the car, and increased pressure upon the street rails, which are only fitted to carry a maximum of five tons distributed over four points, so that each wheel of an ordinary car produces a pressure 1¼ tons upon a point of the rail immediately under it.

The last mentioned objection is easily overcome by distributing the weight of the car with its electrical apparatus over eight wheels or two small trucks, whereby the pressure per unit of section on the rails is reduced to a minimum. With regard to the weight of the storage batteries, relatively to the amount of energy the same are capable of holding and transmitting, I beg to offer a few practical figures. Theoretically, the energy manifested in the separation of one pound of lead from its oxide, is equivalent to 360,000 foot pounds, but these chemical equivalents, though interesting in themselves, give us no tangible idea of the actual capacity of a battery.

Repeated experiments have shown me that the capacity of a secondary battery cell varies with the rate at which it is charged and discharged. For instance, a cell, such as we use on street cars, gave a useful capacity of 137.3 ampère hours when discharged at the average rate of 45.76 ampères, and this same cell yielded 156.38 ampère hours when worked at the rate of 22.34 ampères. At the commencement of the discharge the e. m. f. of the battery was 2.1 volts and this was allowed to drop to 1.87 volts when the experiment was concluded. The entire active material contained in the plates of one cell weighed 11.5 lbs., therefore the energy given off per pound of active substance at the above high rate of discharge was 62,225 foot pounds, and when discharging at the lower rate of 22.34 ampères the available useful energy was 72,313 foot pounds, or nearly 2.2 electrical horse power per pound of active matter. But this active substance has to be supported, and the strength or weight of the support has to be made sufficiently great to give the plate a definite strength and durability. The support of the plates inclusive of the terminals above referred to weighs more than the active material which consists of peroxide of lead and spongy lead so that the plates of one cell weigh actually 26.5 lbs; add to this the weight of the receptacle and acid, and you get a total of about 41 lbs. per cell when in working order. Seventy of these cells will propel an ordinary street car for four hours and a half whilst consuming the stored energy at the rate of 30 ampères, or over 5.6 electrical horse power. The whole set of 70 cells weighs 2870 lbs, which is barely one-fifth of the entire weight of the car when it carries 40 adult passengers, therefore the energy wasted in propelling the accumulator along with a car does not amount to more than 20 per cent. of the total power, and this we can easily afford to lose so long as animal power is our only competition. From numerous and exhaustive tests with accumulators cars in this country and abroad I have come to the conclusion that the motive power for hauling a full-sized street car for 15 hours a day does not exceed $1.75, and this includes fuel, water, oil, attendance and repairs to engine, boiler and dynamo. We have thus an immense margin left between the cost of electric traction and horse traction, and the last objection, that relating to the depreciation of the battery plates, can be most liberally met, and yet leave ample profits over the old method of propulsion by means of animals.

The advantages of storage battery street cars for city traffic are self-evident, so that I need not trouble you with further details in this respect, but I would beg those who take an interest in the progress of electric locomotives to give this subject all the consideration it deserves, and I would assure them that the system which I have advocated in this brief but every incomplete sketch is worthy of an extended trial, and ready for the purposes set forth. There is no reason why those connected with electric lighting interests in the various cities and towns should not give the matter their special attention, as they are the best informed on electrical engineering and already have a local control of the supply of current needed for charging.

Dr. Moses: Will Professor Reckenzaun give us the weight in pounds of the car that he speaks of in Philadelphia and which he wants us to go and ride upon.

Prof. Reckenzaun: I have given the weight of the batteries in this paper. In the car which we use in Philadelphia, there are actually 80 cells, because there are considerable gradients to go over. Each cell weighs 40 pounds and the average horse power each is six. Sometimes we only use two horse power and sometimes, going up grades of five per cent. we use as much as twelve horse power, but the average rate is six electrical horse power. With reference to the weight of passengers on the cars, we have never carried more than 50 passengers on that car, because it is impossible to put more than 50 men into it. There are seats for 24 and the rest have to stand on the platform along the step.

Dr. Moses. What time does it take you to change your battery?

Prof. Reckenzaun: The changing of the batteries takes three minutes with proper appliances. One set of cells is drawn out by means of a small winch and a freshly charged set is put in. It takes the same time to charge the battery as it does to discharge it in the working of the cars, so one reserve set would be sufficient to keep the car continually moving.

Dr. Moses: What loss of energy have you found accompanies the moving of the batteries from the car to the depositary where they are charged?

Prof. Reckenzaun: The car is pushed into the depot where the cells are being charged. Therefore, there is no moving of the cells required with the exception of just taking them out of the car and pushing a fresh lot in and one powerful man can tend to that.

Dr. Moses: What is the loss of energy per diem by allowing the batteries to remain unused?

Prof. Reckenzaun: The loss of energy from standing about is probably nothing. If a battery were to stand charged for eight months in a dry case the loss of energy might be in three months 10 per cent. I purposely had a set of a cells standing for two years charged and never used them. After two years there was still a small amount of energy left. So as regards the loss of energy in a battery standing idle it is practically nothing, because no one would think of charging a battery and letting it stand for three months or a year.

Dr. Moses: That result is exceedingly interesting, as it suggests something that was done by Faraday in determining the length of time that would elapse before a vacuum would be absolutely destroyed. It was there determined that it would take about one year for a Terricellian vacuum to disappear so we have this action really verifying that. It is possible to keep it charged in that way for two years, you say and still allow of some residual charge.

Prof. Reckenzaun: There was a small amount of energy left. There was still electrical energy left after two years. I have had them stand three or four months and I could hardly appreciate the loss going on, providing always that the cells are standing on a dry floor. If the exterior of the box be moist or it stands on a moist floor, there will naturally be a surface leakage going on; but where there is no surface leakage the mere local action between the oxides and metallic lead will not discharge the battery for a very considerable time.

Mr. Powers: When it requires from four to twelve horse power to accomplish the work I would like to know where the loss occurs—if the energy of the street car horse is good for two to six horse power.

Prof. Reckenzaun: I have made experiments in London with a loaded car pulled by two horses. I put a dynamo meter between the attachment of the horse and the car, so as to ascertain exactly the pulling, measured in pounds multiplied by the distance traversed in a minute. You will be surprised to know that two horses, when doing their easiest work, drawing a loaded car on a perfectly level road, exert from two to three horse power. I have mentioned a car in Philadelphia where we use between two and twelve horse power. Each horse is capable of exerting eight horse power for a few minutes, and when a car is being driven up a grade, the same as I see in Boston for instance, pulling a load of passengers up these grades, those two horses are exerting from twelve to sixteen mechanical horse power. That is the reason that street car horses can not be run more than three or four hours out of the twenty-four. If they are run longer they would be dead in a few weeks. If they run two hours a day they will last three or four years. That is 33,000 foot pounds per minute per horse power.

Mr. Phelps: Are you prepared to give an estimate, approximately, as to the life of the cells?

Prof. Reckenzaun: An estimate of the life of the cells, if expressed in pounds, amounts to nothing at all. The life of the cells must be expressed upon the principle of ampère hours or the amount of energy given off through them. Street car work requires that the cells work their hardest from fifteen to sixteen hours per day. The life of the cells is to be divided first into the life of the box which contains the plates. This box, if appropriately constructed, will last many years, because there is no actual wear on it. The life of the negative plates will be considerable because no chemical action is going on in the negative plate. The negative plate consists almost entirely of sponge lead and the hydrogen is mechanically occluded from that sponge lead. Therefore the depreciation of the battery is entirely due to the peroxidation of the positive plates. If we should make a lead battery of plates one-quarter of an inch thick, it would last many years; but for street car work that would be far too heavy. Therefore we make the positive plates a little more than one-eighth of an inch thick. I find that the plates get sufficiently brittle to almost fall to pieces after the car has run daily fifteen hours a day for six months. The plates then have to be renewed. But this renewal does not mean throwing away entirely all the plates. The weight is the same as before, because no consumption of material takes place. We take out peroxide of lead instead of red lead. That peroxide if converted into metallic lead produces 70 per cent. of metallic lead, so that there is a loss of 30 per cent. in value. Then comes the question of the manufacture of these positive plates, which, I believe, at the present day is rather expensive, about eight cents a plate for the labor only. But I believe, the time will come when battery plates will be manufactured like shoe nails and the process of renewing the positive plates will be a very cheap one.

Mr. Martin: How much is the expense for each car mile including depreciation?

Prof. Reckenzaun: I ascertained in Europe that the motive power costs two cents per car mile; that is, the steam power and attendance for charging the batteries. We have to allow twice as much for the depreciation of a battery at the present high rate at which we have to pay for the battery, $5 a box for each cell. But, I believe, that as soon as the storage battery industry is sufficiently extended, the total cost for propelling these cars will be not more than four cents a mile, or about one-half the cost of the cheapest horse traction.

Mr. Martin: Professor Reckenzaun has had the privilege of visiting every one of the electric railways in Europe now in operation. His very valuable obser-

vations on that subject were recently presented to the London Society of Arts, and presented in so able, masterly and exhaustive a manner as to obtain for Mr. Reckenzaun the silver medal of the society. I read Mr. Reckenzaun's paper brought before that society with a great deal of interest, but there was one point which interested me very much, and that was that in Europe the merits, the claims and the advantages of the cable system did not seem to enter into the consideration of the case at all. Here we have to deal with that problem. The cable is running in this country; it is running in most of our large cities where the storage battery must find its chief scope and play, and unless with the storage battery we can make a better presentation than the cable men make with the cable and the grip, it is not likely that we shall see the storage battery assume the position and importance which we believe it is entitled to. I have seen various statistics on the subject of the amount of power required for operating a cable railway, and I have seen some of the statements go as high as a loss or waste of 80 per cent. I would like to ask Prof. Reckenzaum whether since his arrival in this country he has looked into that subject at all, and whether he finds that the loss in getting the current into the storage battery and then delivering it to the motor is less in comparison than that in the use of the cable in the power finally delivered to the car.

Prof. RECKENZAUM: I have made some very careful observations of the cable tramway in Philadelphia, which is quite an extensive system. I have never been able to ascertain the exact amount of waste in pulling the cable itself. But I have it on the authority of certain technical papers that there is a waste of about eighty per cent. I do not intend to depreciate cable or any other tramways, but there is a difficulty about introducing cable tramways. It is necessary to dig up the streets and interfere with the roadways. I have been told that the cable arrangements in Philadelphia cost $100,000 a mile, and that the cable road in San Francisco cost more than that. One of the directors of the cable company in Philadelphia told me that if he had seen the battery system before the introduction of the cable he would probably have made up his mind in favor of it.

The wear and tear in the case of the storage system is also considerable. There is a waste of energy in the dynamo; secondly, in the accumulator charged by that dynamo; thirdly, in the motor which is driven by the accumulator; and fourthly, in the gearing which reduces the speed of the motor to the speed required by the car axles, because it would be difficult to make a motor run at the rate of eighty revolutions to the minute, which is the number of revolutions on the street car axle when running at the rate of ten miles an hour. Take all these wastes and you find in practice that you do not get more than forty per cent. of the energy given by the steam engine on the car axles. But this is quite sufficient to make this system much cheaper than horse traction.

I haven't the least objection to a direct system. But when you come to run twenty, or thirty, or fifty cars on one line, you will require such conductors and such electromotive force that it would be impossible to insulate it. The overhead system is applicable to its own particular purposes, to a line running. Where there are only five or ten, or even twenty cars running on one line, and that line runs through a suburb or a part of a city, where there are many houses, that system is to be preferred. The objection to the overhead system is not the want of beauty, but the want of practicability. You have to put your posts very high indeed so as to let great wagon-loads of hay and all sorts of things pass underneath. And then you find that trouble comes in winter. When it is snowing hard a great many difficulties arise. Yet I would advocate that system anywhere except in city traffic. As regards the loss, suppose that the resistance of the overhead lines is one ohm, to draw one car will take an average of 20 ampères, and the only loss will be 20 multiplied by 20, that is 400 ampères through line resistance. But if there are ten cars, on that line you get 40,000 watts loss of energy, unless you increase the conductor in proportion to the number of cars. If you do that, when you get 100 or even 50 cars, you get an enormous conductor and have a sort of elevated railroad instead of a telegraph wire, as most people imagine an overhead conductor to be.

The current required to run a street car is about 30 ampères, and an electro-motive force of about 180 volts. If cars are run in connection with an incandescent light station, we can arrange our apparatus so that we can use an e. m. f. say, of 110 volts, and then we can put in a smaller number of cells with a larger capacity that will give a greater horse-power. We can charge them with 50 or 60 ampères instead of 30.

The arc lighting dynamo can not be used to charge the accumulators. That is to say they can be used, but they would require such constant attention as to make them impracticable. We can only use shunt wound dynamos for that purpose.

Mr. DECAMP: You stated in your paper that you had 80 cells of 40 pounds each. That makes 3,200 pounds. That is for the batteries alone. Now what proportion does the weight of the dynamo bear to that of the batteries?

Prof. RECKENZAUN: It varies. The motors that are used in Europe weigh 700 pounds, for 16 horse-power.

Mr. DECAMP: Then that 700 pounds is to be added to the 3,200. Now you said that one-fifth of the weight of the car carrying forty passengers consisted of this apparatus. You must be in error in some of your figures, are you not?

Prof. RECKENZEUM: I have figured it out where we are using 80 cells, as in Philadelphia. In Europe we only use 70. They are sufficient for the speed with which the cars are allowed to run there, which is only seven miles an hour. The entire apparatus of a European car, including the motor and the battery, is but 2½ tons. The total weight of the car filled with passengers, is seven tons.

Mr. DECAMP: It seems to me there is an error in the figures somewhere. If you are going to double up the load of the street railway car, that is a very important factor in the economy of the system. I had an off-hand statement from one of the active directors of the cable system in Philadelphia that just one-half of the power was required to run the cable without any car. Now, if you double that up as you are doing by batteries, see where it will land you in the amount of power consumed. The weight that you put on in motor and battery, without regard to the extra gearing, is in round numbers, 4,000 pounds. But that the car that the cable road pulls does not exceed 7,500 pounds.

Prof. RECKENZAUN: I am not aware what amount of loss there actually is in the cable cars. I have given you the weights and figures. Now, with regard to the figures, I have said that I believe that one-fifth of the entire weight of the car and passengers is used for the accumulators and motors. I believe the figures are correct.

Mr. DECAMP: How many hours would be consumed in charging a battery of 80 cells if it was run 15 hours? Suppose you charge for an 80 ampère current. That would be 30 times 15, or 450 ampère hours.

Mr. RECKENZAUN: The batteries have to be charged every three or four hours. They are capable of running four and one-half hours on the Philadelphia track; but we prefer to change them every three hours and leave a large margin of charge in them. We should have to exchange the batteries probably as often as the horses are changed. The capacity of these cells is 450 ampère hours, but they are probably charged for 120. When they are returned we charge them as much as they have been discharged. It is very easy to ascertain the amount of energy required on any particular line.

Mr. PENDLETON: I understand that the loss of power in drawing the cables in Philadelphia was ascertained at 50 per cent. In San Francisco it was 68 per cent. used in drawing the cables, 28 per cent. in operating the cars, and 4 per cent. in carrying passengers. In the remarks made by Professor Reckenzaun I understood him to say that he considered the shunt-wound dynamo essential in charging the storage battery. The last opportunity that I had to speak on the subject of a storage battery was in Boston, in December, 1882. I see some gentlemen present who heard the lecture I delivered at the School of Technology at that time, with the first storage cells which were manufactured in this city. I have had in continual use a dynamo for the purpose of charging storage batteries, but I found it necessary to use a current-breaker in order to avoid the reversal of the dynamo, which at one time bothered me a good deal. I think perhaps there is no other difficulty whatever in using any ordinary series dynamo, although the shunt-wound dynamo has certain advantages for general use. I am reminded by a reference to the direct system of transmission, that about a year ago I was asked the question by the board of directors of the Brooklyn City railway, what the difference in cost was between the direct transmission of electricity for the purpose of propelling cars and the storage battery. It was a complex question, and I felt that it could be solved by a diagram more readily than by language. Therefore, I drew two parallel lines of rails, supposed to be five miles in extent, and I pointed out that the resistance of the circuit, when it reached a sum to divide the power developed at the station, would make the secondary battery beyond that the most economical. On one occasion, before the New York Electric society, where we were debating the subject, I mentioned a method which we had of using direct transmission near the station, charging the batteries and operating the motor by means of a commutation of the battery, and then utilizing the chemical energy at the extreme ends of the route. A storage battery might be able to work far more usefully than by merely exhausting a charged cell. I believe that, under the circumstances, a secondary battery can be made to operate a car for a day, or fifteen hours, without removal, and only required to be removed when, by extra discharges, the motor became heated or required attention in the battery hospital, which every car station must have.

Mr. MAILLOUX: I am largely interested in the problem of street car traction with accumulators, inasmuch as I happen to be consulting electrician for the company which I believe put the first street car propelled by accumulators into commission—a car run on the Madison and Fourth Avenue lines in New York city. Some of the data, which I add by way of corroboration or comparison with those of my friend Mr. Reckenzaun, might perhaps be interesting. The grades on that line, as some of you may know, are extremely severe; not only that, but they are long, so that they tax not only the capacity of the motor but that of the battery very severely. We have on one part of the line a grade of nearly five and a half per cent., and there are a number of grades as high as four per cent. Besides that, in several places the grades happen to be on curves, which add greatly to the effort required by the motor to propel the car. We have found that it was preferable to use two motors instead of one. We think it would be better to use motors rather larger than necessary in order to obtain larger efforts with a comparatively high efficiency. We use 130 cells, which weigh somewhere in the neighborhood of 3,000 pounds. The whole car, with the motor and batteries, weighs nearly six tons, without passengers. This weight is altogether excessive, and for this reason the car has very strong iron beams. It was strengthened in Europe before it was sent over here, with the idea that we might want to carry enormous weights upon it.

One of the other questions that I wished to ask Mr. Reckenzaun was as to the amount of electrical energy per mile that he finds necessary. I have found, as the result of repeated observations, that we must count upon an electrical supply of energy equivalent to from one to one and two-tenths electrical horse power per car mile. This means that if we have a supply of electrical energy equal to, say, 40 electrical horse power hours we have enough energy to run somewhere between 35 and 40 miles. In practice we do not deem it expedient to exhaust completely the capacity of the car, and we find that a run of 30 to 35 miles is all that it is best to make in the ordinary every day work of a car. We find therefore that in the average day's run of 60 or 70 miles it is necessary to change the accumulators twice a day. The car would start with a charge in the morning and would change about the middle of its work, irrespective of the number of hours that it had been in operation, because the number of hours run includes the stops. You will see therefore that the mere time necessary for changing the batteries becames quite insignificant when there are only two sets of them to be changed in one day. So that I do not think the objection advanced by Mr. Pendleton has very much force, in this case at least.

The question of transmitting the power from the axle of the motor shaft to the wheel shaft is one that has received a great deal of attention. I know that Prof. Reckenzaun has gone over that subject very carefully in Europe, and that he has some original plans and systems of his own. I think it would be very interesting if he would tell us of his experience. In one system we have found it preferable to use a counter shaft in order to reduce the speed of the motor, but the reduction which we obtain is perhaps larger than it regularly could be in practice. We reduce in the ratio of nearly one in ten. In other words the motor runs nearly ten times as fast as the shafting.

In considering the expediency of a change, it becomes an important question to determine how quickly and how rapidly that change shall be made. It is there that the secondary battery system undoubtedly presents great advantages. If this system is to be operated by any overhead conductor or underground conductor, it is necessary that we should go at once to the expense of organizing the system of conductors completely from one end to the other. We must provide facilities, before we can run one car, for establishing a circuit for as many conductors as may be necessary. It does not matter whether part of the system is operated by electricity or part by horses, because they are independent of each other. The only thing that we have found in practice is that we have to be careful not to run into the other cars, because there is one point which must be borne in mind, that just the same as the electric light, when it first came, not only gave us cheaper light but gave us more of it, so the electric street car system not only gives us very good locomotion, but gives us very much better speed. Now, in the upper part of the road in which we have this system there is a suburban end which extends from 86th Street to Harlem. There are very severe grades there, but the patronage is not very large, and is more suburban than anything else. There they run some thirteen cars. The superintendent of the road, with whom I happened to be on the car one day when they were making experiments, told me voluntarily that with the electrical street system it would be possible to give the people in that neighborhood something very close to rapid transit It would be possible to run all the cars at a much faster rate of speed, —it would be permissible, under certain conditions, when it is remembered that the line is almost entirely in the suburbs of the city,—and in that way the time of making the trip would be very much shortened. We found that we could very easily attain a speed of twelve miles an hour. Of course we are not at liberty to make very lengthy runs at that speed, but we have experimented with the line during the night several times, when the tracks were entirely free, and in that way we have been able to determine pretty accurately the rate of speed that might be maintained.

In regard to the charging of storage batteries by arc light circuits; there is perhaps some misapprehension in my friend's mind. I do not think that with small dynamos it would be possible to use them; but in speaking of charging storage batteries as we understand it, commercially, it it would no doubt refer to a few storage cells of an arc light circuit. As the e. m. f. of the battery would be very much smaller in comparison with that kind of electric dynamo machine, there would be no difficulty whatever. The only disadvantage is that of low rate of current to which the arc light circuit has gradually been dwindling, and we find that in a great many cases it is not more than 6½ ampères. In that case it would take something like between 22 and 24 hours to effect a complete charge.

In speaking of the duration of the plate, I believe, Professor Reckenzaun assumes the working hours of each battery at fifteen per day. Now, if they are going to be changed until they will not be working that length of time, does he include in the operation of the battery the operation of charging as well as discharging?

There is another important thing in relation to the electric railroad. It is the question of braking by electricity. I found that railroad men, conservative as they are, when once they conclude to adopt electricity, like to have everything done by electricity on the car, and one of the first questions which they propounded was as to the practicability of braking by electricity. I know of an electrician who proposed to use the motor in charging a battery while descending a grade, which would produce an intermittent charging. I confess that I do not see very much margin to be expected from this, judging from what has been developed, up to the present time, in the way of economy or gain, but I should be interested in hearing the views of so experienced an electrician as Prof. Reckenzaun on that subject. With the car that we are running on Fourth avenue we were enabled to run up a high grade with a load of some of thirty passengers, with an additional car attached containing some few passengers more; but the superintendent was not satisfied with that. He made a stop on the grade, and, after stopping, a start was accomplished without any difficulty.

Mr. PENDLETON: I see that Prof. Reckenzaun is making some notes, and, if the president please, I will say a word in reply to Mr. Mailloux. Inasmuch as the accumulators are so rapidly changed, there can not be very much difference. Instead of having two sets of accumulators to the car, you would have only a few additional accumulators, which would be a manifest gain. I desire to call Mr. Mailloux's attention to that matter in answer to his remarks.

Prof. RECKENZAUN: In regard to using two motors on a car, there are several advantages. I use two motors in every car in Europe, and always have from the beginning. One of them is, that in case of an accident to one motor the other will bring the car home; secondly, with two motors we can vary the speed without changing the e. m. f. and the battery. If I want very much power I put two

motors in parallel, getting four times the power that I do with one machine, and an intermediate power of two motors. There is another advantage of having two motors, and that is that we have two driving axles instead of one, and we can go up grades with almost double the facility, because the adhesion is double. These are the main advantages arising from the use of two or more motors. You might introduce more eventually, perhaps. Mr. Mailloux asked if I would give my experience in regard to the mechanical transmission between the motor and the car axle. I have used almost everything that was known at the time, but, in order to give you a full and detailed account of the various modes of transmission which I have used, I should have to give you figures to bear out certain experiments, which I should be able to do only in a lecture which would take at least five hours; so I hope that you will kindly excuse me on that point.

With regard to the durability of plates, I have taken into consideration fifteen hours a day.

In regard to the application of electrical brakes, I will say that that was one of the first ideas that entered my head when I began to use electric motors, and people had that idea long before I. I have used an electric brake, using the motor itself as a brake; that is, as the car runs down a grade, by momentum it generates a current; but this current can not be used for recharging a battery. It is utter nonsense to talk about that, unless we have a steady grade four or five miles long. The advantages are very small indeed, and the applications which would be introduced by means of automatic cut-outs and governors, and so on, would counterbalance anything that might be gained. In regard to going up an incline, of course, stopping and starting again has to be done often, and any one who at any future time makes cars to work by electricity, whether they have storage batteries or not, has to make sufficient motive power to overcome all the difficulties that any line might present. One of the great mistakes which some of the pioneers in this direction made was that they did not put sufficient power upon the cars. You always ought to put on the cars power capable of exerting perhaps 20, or 30, or 40, or 50 per cent. more than is ever demanded in ordinary street service, so that in case of being snowed up, or any other accident which is liable to occur, you would have plenty of power to get out of the scrape. Mr. Pendleton made certain suggestions in regard to a combined system of conductors and accumulators. I do not know much about those, and I could not give an opinion unless I had studied the matter thoroughly.

Mr. KINSMAN: What would be the effect on an accumulator of intermittent charges such as the gentleman spoke of in going down grades?

Mr. MAILLOUX: It would not have any bad effects so far as that is concerned. It is merely a question of the expediency of the process, whether there would be sufficient energy gained by it to make it worth while.

Mr. KINSMAN: Are intermittent charges economical and desirable?

Mr. MAILLOUX: I do not think it matters very much whether the current be intermittent or not. There may be a slight difference in fluctuation of the electro-motive force by virtue of the variation of the rate of charge, and that might affect the efficiency of the storage battery as an instrument for conversion, but it would not affect its storing capacity to any appreciable extent.

On motion of Mr. Duncan, data that had been prepared in regard to the number of motors in operation at central light stations, prices paid, etc., were referred to the executive committee for revision and distribution among the members of the association.

The committee appointed to recommend a place for holding the next meeting of the association announced that Pittsburgh had been selected. The date in February will be determined by the executive committee.

Dr. Otto Moses, Stephen Holbrook and F. A. Gilbert presented their resignations as members of the executive committee, and S. A. Duncan of Cleveland, T. Carpenter Smith of Allegheny City, and Wells W. Leggett of Detroit, were elected to fill their places

Mr. LEGGETT: I believe that it was stated at the opening of the meeting that we would talk up the matter of underground wires at the close of the session. In Detroit we are lighted by the tower system. We have some four hundred miles of wires in our system there. Just at the present time our city council, our board of trade, and our mayor, all of them very excellent gentlemen who have at heart the welfare of our city—and there is no question but that they have at heart also the welfare of onr company—have deemed it expedient to immediately stop the operation of running the wires underground. Now we are met with this condition of affairs, that we do not know what to adopt. We would be very glad to have the views of this convention, or the views of such members of it as have had experience in this line, and to know if there is any system which any one can recommend that is beyond the experimental stage. We have invested in the city of Detroit nearly half a million of dollars in our plant, and you can readily see that we are driven to an extremity. That, of course, to us is a matter of very grave importance. We want to know whether we are obliged to take one of a number of things, each of which is experimental, or whether there is some system which some member of this association can say that he has found to be expedient and practicable throughout for this purpose.

I must confess that after all our investigations in this matter, we are as yet entirely undecided to know what to do. We recognize, as well as our mayor, our board of public works, and our city council, that this matter of overhead wires is becoming very serious, interfering with fire ladders, and causing more or less danger to property and to person; but the remedy is what we are seeking. If there is anything which we can adopt, we would be very glad to adopt it. For that reason I hope that there will be short remarks from a number of sources—the experience of different individuals in this line—whether there is anything that they can recommend directly. I should also be glad to know of the difficulties that they have experienced in regard to the matter. I would like very much if Mr. DeCamp would state briefly whatever experience he may have had with the matter in Philadelphia; and, if we have a representative from the city of Brooklyn, I would also like to hear from him.

Mr. DECAMP: All that I can do is to state the facts of the case as it exists in Philadelphia. As Mr. Leggett says, it is certainly, with us, not beyond the experimental stages. There has probably been more work done in that direction in the city of Philadelphia than in any other city in the country, and this is the condition of it: The department known as the electrical department of the city of Philadelphia, about a year and a half ago, made an appropriation of $5,000 to put down a line about one mile long. A lead-cased cable, well insulated, was put in a trough, and the trough filled with residuum of petroleum. That carried twelve lights of 30 volts each, which was the extent of that particular line. At the end of about a year, a further appropriation permitted the department to extend its line. It however was not extended in a double line. The remainder of the circuit was made on one side of the circuit, and the other was taken overhead. That has been in operation about six months. It is now carrying a load of 45 volts each, and has been doing that for probably the last three months. The cable is working fairly well, but from various causes has had more or less grounds—very many more than the overhead circuit. Additional experience was recently had in South street, where there was a circuit of one mile put in. The first circuit put in was a failure. The cable, which is there to-day, is a good one, but the superintendent tells me that the grounds are so numerous that he hardly knows where to commence to pick them out, and there they are to-day in that condition. Whether it is the fault of the cable, or of the conduit, or of the work done, I do not know. That, however, has brought us to this conclusion: That we have got to replace all of that before we shall be justified in running lines over such a circuit.

The sectional underground wire operated by the Electric Light & Power company, of which I am the manager, is the latest experiment in the way of underground electric lighting which we have in Philadelphia. I have been manager of that company for six months. The gentleman in charge of that is a clever man, and a man of more practical experience in the operation of underground wire, I think, than almost any other man in the country. He is a man of exceptional intelligence, and is an enthusiast in his work. He has left no stone unturned to look into the difficulties which we have experienced and to try to foresee them. The conduit itself I believe to be one of the best structures in existence. I am speaking now merely for its convenience. It is an iron conduit. Previous to my taking charge of it, I do not know how many cables they had in.

Mr. BROWN, of Chicago: I have had about eighteen months' experience with underground work in Chicago. We have there the Dorsey conduit and are troubled greatly with gas, and have had two or three explosions, although they have not caused much damage. We find that the principal trouble with the conduit is at the joint. We think if a perfectly tight conduit joint could be made that we would not be so much troubled with gas and even water that leaks in. The newest conduit which we know of in Chicago is the Hurlburt conduit, which has a flexible joint. It has been on the market but a short time, and I do not know that any of it has been laid. But it seems to me that it would carry out the expectations entertained regarding it from the fact that the joint is flexible. We have man holes at an average distance of 400 feet apart, and between the man-holes we find that the conduit sags after it has been laid any length of time from the pressure of the street traffic. We have some sixty or seventy miles of wire under ground, and in that quantity nearly all classes of cable underground wire are represented. We tried lead-covered cable at first and finally thought it was best to give that up, but lately have gone back to it. We find that in places lead-covered cable fills the bill. On our main circuits running from the station we think it is best to make them of lead, and after we leave the conduit, running through the laterals under the sidewalks, we find it best to have something besides lead cable, because on all arc light circuits we have to get them everywhere and anywhere at all times to put in and to take out lights. Lead-covered cables I don't think quite fill the bill under the sidewalk. We find it necessary, as I say, to have white joints on the lead cable, and when we do leave the conduits to leave lead cable for good and put in some other wire We also have great annoyance from the rats. They eat the lead of the cable. You can see where their feet burn on the cables, and their tails, and we find them on the ground with their noses burned off.

Mr. POWERS: I have been in the past year somewhat interested in this underground question. The principal cities of the state of New York, the outside of New York and Brooklyn especially, have been greatly exercised during the past year on account of the interference of the wires with the ladders of the firemen at the Buffalo hotel fire, and on account of that a number of bills were introduced and two or three were passed by the legislature and signed by the governor, allowing wires to be put underground with the consent of the local authorities. We told the contract board of the city of Troy that we would forsake our contract and would make no contract with them under any conditions that did not contain a clause eliminating the underground business—in other words that our contract should be binding as long as our wires were overhead. Unless we are going to have a great deal of trouble, in the small cities especially, it is necessary for the electric light men to take an uncompromising attitude. People say that because they want the wires underground is a sufficient reason why they must go underground. That is all they know about it. A prominent paper of the state of New York actually urged as an argument that because an Edison company in the city of Albany put their wires under ground that we in the city of Troy should put our wires under ground. With that state of ignorance, it is the business of this convention to enlighten people on that subject as much as possible and also to take the most uncompromising attitude toward forcing the wires under ground. Let them understand that it is not possible, in the present state of the art especially, where lights are spread over a large area.

Mr. DECAMP: Mr. Powers' remarks call to my mind a little early experience I had with legislative matters. About the first year we started there was a bill brought up in our council taxing overhead wires. It was made $5 a mile for telephone and telegraph wires and $12.50 a mile for electric light wires. I said, "Gentlemen, I do not understand that; why should an electric light wire be taxed more per mile than a telegraph wire." One of the members turned around and said: "What is your name? Where are you from?" And then he moved to amend by making the tax on electric light wires $15 a mile. That is the way your arguments, so far as this is concerned, are met.

Mr. LAW: In Philadelphia we have had considerable trouble in conduits from the explosion of gas. Our lines are erected on iron poles made of gas pipe, and in two places lately we have cut holes in those poles and connected them with the conduits. I noticed that there was a considerable escape of gas from the top of those poles. I was up one of them the other day examining it and it is very perceptible there. I would like to ask if there have been any experiments made in that direction.

Dr. MOSES: There is a matter that might be reported upon at some future meeting, and that is the influence of electric currents, both continuous and alternating, on small masses of magnetic matter and on the demagnetization of the same. That is intended to cover the question of the rapid magnetization and demagnetization of small masses of iron used in measuring instruments and also what is the effect of currents large and small upon watches, which are in everybody's pocket, and whether it is possible for them to be demagnetized, when once they are really magnetizedt by any appliances we have. It is a question of great im, portance, when you consider that the first chronometer thawent accurately was the means of bringing the inventor a reward of £20,000 from the British government. You can see it is a matter of importance to have timepieces absolutely accurate for certain purposes. All of the chronometers used on board ship contain masses of iron in them, and it would not be pleasant to have somebody come down on an electric light company for causing the magnetization of the chronometer and thereby bringing about the loss of a ship.

Dr. Moses' suggestion was embodied in a resolution and carried. E. Lange, of Pittsburgh, was appointed on the committee.

On the committee on insulation, etc., to take the place of those who resigned, Prof. Thomson, of Boston, Dr. Otto Moses, of New York, Dr. L. Waldo, of New Haven, Dr. Duncan, of New York, E. Lockwood, of New York, George Hamilton, of New York, O. M. Shallenberger, of Pittsburgh, were appointed.

Mr. DUNCAN: I was not present yesterday morning when the report of the carbon committee was presented, but it seems to me it would be well to take some action preparatory to the next meeting, to look into this question of carbons very thoroughly either through the executive committee or by some special committee, because if we have got to break down a pool every two months we ought to be in shape to do it; it seems to me that from the information which has been going around—not in the convention itself, but from mouth to mouth—in regard to the formation of an organization and the prices desired to be obtained by the old pool, that the time has arrived for the companies interested here, through the committees of this association and through its proper officers, to look after that subject very carefully. It seems that we have been able in the past to get along very comfortably with the pools but I can conceive of circumstances where it might take considerable time to break up a combination. As I understand, the committee that reported yesterday morning was discharged. If they were discharged I should make a motion that a committee of three or five be appointed to take this matter in hand and that all papers pertaining to carbon be referred to that committee for report at the next meeting and that they have power at any time to call the attention of the executive committee to any proposed action such as has taken place within the last few months. I think it is high time that we protect ourselves as well as the parent companies protect themselves in the manufacture of carbon.

At the request of the president Mr. Duncan put his motion in writing as follows: "*Resolved*, That a committee of three be appointed by the chair to inquire into and report on all matters pertaining to the carbon matter," and the resolution was adopted.

The convention was then adjourned.

SOCIAL FEATURES OF THE CONVENTION.

The excursion and banquet tendered to the members of the association and their guests, the afternoon and evening of the 10th, under the auspices of the Boston Electric club, through the courtesy of the city of Boston and the Thomson-Houston Electric company, was a complete success. The sail down the harbor to Deer Island was thoroughly appreciated. A tour of inspection was made of the House of Industry under the guidance of Col. John C. Whiton, superintendent, and the party then partook of a lunch provided by the city of Boston. At the conclusion of the lunch the party re-embarked for Nahant, where barges were in waiting to convey them to the immense factory of the Thomson-Houston company. The visit to this magnificent establishment was entertaining and exceedingly instructive. Expressions of surprise were frequently heard at the colossal scale on which the business was carried on and the extraordinary facilities provided for handling the business. Re entering the barges, the sightseers were conveyed to the Revere Beach depot, where a special train was in waiting to bear them to the Point of Pines. In

the evening the party sat down to a sumptuous banquet provided by the Thomson-Houston Electric company. Mr. Ridlon, president of the Boston Electric club, called the party to order, and introduced Dr. Moses as presiding officer. In the course of his happy remarks, he called for three cheers for the host of the day, the city of Boston and the Thomson-Houston Electric company, which were given with a will. Dr. Moses continued: "I am reminded of a sentence in one of Auerbach's novels, when a little child was asked by its mother, 'My dear, do you see the forest?' and the child says, 'Forest, mamma? I can not see the forest, there are so many trees there.' Now, I could not see the Electric club through so many trees as we had to-day, and that is the reason why I did not refer to them. But that we may not forget that circumstance, I would like more formally, in our name here, to thank the president and members of the Electric club for the magnificent entertainment they dispensed here, and I suppose that the example that has been set by the Boston Electric club will be followed by all the other electric clubs in turn, in the United States, as they form. Now, then, gentlemen, for a blare of trumpets that is going to come. I beg to introduce to you, for a few minutes' conversation, one who, more than any one else, has contributed to the success of the Thomson-Houston company and to the pleasure of this association, during their visit to Boston—let me introduce to you Professor Elihu Thomson, a man and a name that I delight to honor.

Mr. Thomson: Gentlemen, I assure you that this is an entirely unexpected honor, for me to be called upon to say anything to you to-night. It gives me great pleasure to meet you upon such an occasion. I hope that it will be only the beginning of a long series of such pleasures in the future. I will say that I knew very little about the present arrangements, and to myself they were news when Dr. Moses presented them to you. My field of work has been rather more in the line of the development of electrical apparatus than speaking in public; and I therefore must, with these few remarks, beg your pardon for not continuing any further.

Col. Ransom was next called upon, and regarding the electric light industry, said: "The electric light industry now commands the services of very many of the best men and the most intelligent men that this country contains within its borders. And these men are engaged in this business and they are in it to stay. They are not going to retire from the field. With such men as Mr. Ridlon, whose superior judgment, suavity and intelligent work command the respect of all who know him; with such men as J. F. Morrison, whose energy, whose pluck and whose determination to succeed are certain to command success; with such men as the sagacious and whole-souled Alexander, who knows no such word as fail; the versatile and incomparable Slattery, who conquers by his logic; and with such a broad-gauge man as Mr. Coffin, of the Thomson-Houston system, who occupies the same relative position in his specialty as did the late Col. Thomas A. Scott, of the Pennsylvania railroad, whose wisdom and sagacity were nowhere more clearly shown than in the character of the lieutenants he secured to aid him in his great enterprise, is it any wonder that the electrical interests have taken such giant strides in all the improvements that look to perfection, as a result of intelligent and well-directed effort?"

Mr. Slattery, in answering for the Boston Electric club, made a happy response.

President Morrison, after acknowledging the three enthusiastic cheers from the members at the board that had accompanied the chairman's announcement of his name, said: "You have here, in my judgment, the cream of the manhood of the electric business of the United States. One of the speakers in the National Electric Light association to-day—I think Mr. Steuart of Baltimore—said that on that floor was represented twenty-six of the states of the Union. What did that mean? Why, it meant that on the floor of the Parker house to-day stood a full representation from twenty-six states of this union, showing the intelligence, and the nerve and the pluck of the men who have stood at the front and made a new business a phenomenal success in the short period of eight or nine years. Mr. Steuart asked you to assist him in reorganizing the patent laws. He asked you to go to the congressmen of your districts and give him the needed aid to clean out that nest of politicians, and put in their places men of science who know and understand their business. When this association struggled into birth in the city of Chicago, two years and a half ago, its most earnest advocates could have hardly looked forward to such a meeting as is present at this sixth semi-annual meeting of the National Electric Light association. A few men gathered together in the Grand Pacific hotel at Chicago, and held themselves bound by the ordinary or extraordinary ties of intelligence such as is rarely possessed by any executive body. They have grown from the small handful of men to the three or four hundred men who have sat down here at this banquet of the Electric club of Boston, under the auspices of the Thomson-Houston Electric company in this beautiful place to-night. Are we not rewarded for our labors? Don't you feel proud to belong to the National Electric Light association? Is there a man here who does not feel a thrill of glory such as soldiers sometimes feel when you look down these well-filled ranks to-night? Honor after honor has come to me, yet I will say that I am as ready to serve in the ranks of your association as in the office of president."

Mr. Coffin, of the Thomson Houston company gracefully acknowledged the presence of the guests of the evening and said: "It is unusual, it is impossible, to find in all the fields of industry, in my opinion, anything which attracts so readily, so spontaneously, such a large percentage of our educated, earnest young men of convictions. With regard to the future of electric lighting, these men believe that if it is promoted, first, upon scientific, truly scientific, principles, and, secondly, upon business principles, it must succeed. It is impossible to look upon the faces of the gentlemen here assembled to-night and not be convinced that those of you who can not be scientific electricians are earnest and determined to promote your business upon a business and manly principle, with the intention to get the most that can be got legitimately out of the business. It is my pride, gentlemen, that young men leaving the colleges are flocking around the standard of this comparatively new industry. A gentleman has left the army, a gentleman whom I hoped to see here to-night, a lieutenant of fine and high promise, and turned his back upon all that his position promised him if he would remain in that profession, to take up the more promising work of electric lighting. We have here, I am happy to say, not in the electric light business directly, but in that which contributes to it, without which electric light is not possible, the carbon business, the son of an honored ex president of the United States. These things will in themselves show the attraction of the new industry, of which we are proud to be the standard-bearers Our honored president also informs me that we have some half a dozen members of the United States navy, who, strange as it may seem, forsake the navy of the United States for the field of electric lighting. More strange than all, perhaps, we have several representatives here of that field of manufacture, —that honored field—I am talking with perfect respect and admiration—that antiquated field of manufacture—that of the gas companies. Now, gentlemen, I feel very much as though, if I talked to you longer, somebody would say to me, as a good old Methodist deacon said, of a fellow Methodist deacon, in prayer meeting. He said, 'I wish Brother Jones was in hell.' It created a sensation. But he insisted that he was honest in saying so, because if Brother Jones was in hell he would break up the whole institution in less than six weeks. I am also reminded of a colored preacher, an earnest soul, who was once preaching about the sins of his parishioners, and who said that of all sinners the worst was the one who robbed his neighbor's hen roost Some layman got up and said, 'Hold on, there, brother, you are throwing a coldness over this meeting.' Now I fear that I shall throw a coldness over this meeting. I will say no more except to return sincere and heartfelt thanks to these our hosts of the evening, whose grateful guests we are, the Boston Electric club. I only regret that there are not here present representatives of the city of Boston, the bounty of which city we have been the grateful recipients of to-day. Hoping, gentlemen, to see you again soon, and hoping this convention may be presided over in the future by a gentleman of as great earnestness and as great executive ability as are possessed by the president whom it has been your good fortune to have in the past, I will bid you good night."

Messrs. Slattery, Steuart, Barton, Kerr, Duncan and Reckenzaun were successively called upon, and in time to take the 11 o'clock return train, the banqueters brought the double feast to a close.

The entertainment and reception committee of the Boston Electric club consisted of P. H. Alexander, chairman, F. A. Gilbert, A. H. Chapman, Capt. B. S. Flanders, R. F. Ross, M. M. M. Slattery, Wm. Brophy and Geo. W. Adams, and to their efforts much of the success of the occasion was due.

Thirty-five representatives of the Thomson-Houston company in different sections of the country met at Young's hotel Thursday evening and after partaking of a banquet provided by the parent company exchanged experiences on matters pertaining to the different appliances manufactured by the company.

NOTABLE EXHIBITS.

The Standard Underground Cable company, of New York, represented by G. L. Wiley, had an attractive exhibit of underground, submarine and aerial wires and cables.

The New England Telephone company, through A. H. Chapman, their courteous superintendent, placed a telephone in the convention rooms for the benefit of the members of the association.

The Washburn & Moen Manfg. Co., of Worcester, made an attractive display of their wire products in a large glass case.

The Fiberite Manfg. Co., of Portland, Me., represented by C. A. Brown, manager, showed several jars made from ground wood pulp for primary and secondary battery purposes.

The Okonite company made an exhibit of their wires and cables for general purposes and their special electric light wires, cords, etc. G. T. Manson was in charge.

The Schaefer Electric Manfg. company had an exhibit of lamps, switches, fixtures, etc., demonstrating the practicability of its system of incandescent lighting on any arc or alternating circuit.

Annunciators of different styles were shown by Blodgett Bros.

C. McIntire & Co., of Newark, N. J., manufacturers of patent electrical wire connectors made a neat exhibit of their patent joints for electric wires.

The Leatheroid Novelty Co., of Boston, showed a sample board of leatheroid novelties for electrical purposes.

The Scoville Manfg. Co., of Waterbury, Conn., exhibited samples of silicon-bronze wires and high resistance German silver wire.

An ingenious gauge for use on arc light circuits, and pocket gauges for testing light circuits, were shown by the Standard Electric Time Co., of New Haven, Conn. C. D. Warner and G. M. Chapman were the representatives.

Kimball & Davis, of Boston, exhibited their new dynamo for incandescent lighting—70 volts, 50 lights.

The Billings & Spencer Co., of Hartford, Conn., showed a large number of samples of its drop forgings of copper, iron and steel, also eye-bolts and wrenches.

The Simplex Electrical Co., of Boston, represented by Dr. A. F. Mason, had two of its arc lamps in operation run from an incandescent circuit.

Electrical apparatus and instruments were shown by A. L. Russell.

Kerite was represented by C. B. Hotchkiss and R. W. Pope.

A sample board of rubber tape insulation was shown by the Boston Rubber Shoe Co., represented by G. L. Richards.

"Little Giant" batteries and the Wright cable clip for hanging telephone cables were shown by the Rhode Island Telephone & Electric Light Co. of Providence, R. I.; R. H. Whittier, the manager of the company, was in charge.

New York Insulated Wire company of New York, manufacturers of the Grimshaw white core wires and cables and Grimshaw tape, exhibited a full line of their products, in charge of J. W. Godfrey of New York, the general manager of the company.

Charles L. Ireson, manufacturer of self-adjusting leather link belting, showed a belt in actual work.

The Bernstein Electric Light Manfg. Co. exhibited its method of running incandescent lamps on arc-light circuits, showing its 125 candle power lamps in direct series with the arc lamps, and its 30 candle-power lamps connected two in multiple.

An interesting device for starting and stopping dynamos was shown by the American Machine & Tool Co., under charge of W. H. Barker, of 87 Kingston street, Boston.

The Para Rubber Co. of South Framingham, under the supervision of J. B Thomas, showed conductors with rubber insulation. A quantity of this wire was used in the installation of the Sun company's alternating system at the convention, put in by the Boston Electric Light company.

A fine display was made by the New England Glass Works of Boston of arc-light globes. Of particular interest were their new patent semi-obscured globes. The invention in regard to the new globes consists in a process of roughening the surface of the globe, which thus absorbs from 10 to 15 per cent of the light only, which is much less than by any other process, but at the same time tones the light sufficiently to make the globe very desirable for inside lighting.

Non-magnetic watches in great variety were shown by the Geneva Non-Magnetic Watch Co. of New York. The principle on which these watches are constructed was recently described in this paper. As the watches are absolutely uninfluenced by magnetism their value to workers around electric appliances is apparent.

A new departure in hydraulic engineering, consisting of an electric motor and double-acting force pump combined in one machine, were shown by the Edgerton Electric Motor Co. of Philadelphia, Prof. N. H. Edgerton and W. E. Sharpe being in charge. They also showed a motor running a fan, another a coffee mill and still another operating a boot blacking apparatus.

The headquarters of the Western Electrician were illuminated by the lamps of the Vitrite & Luminoid company, who were worthily represented at the convention by Romaine Mace. These lamps were also strung through the rooms of the Cleveland Electric Motor company, and in the halls, and were noticeable for their white and brilliant light.

The Cleveland Electric Motor company was strongly represented by Messrs. Wright, Pettingill, Mansfield Miller and Hungerford. Motors of large and small sizes were shown running, some of their small motors showing particularly strong capability for handling heavy work.

The Callender Insulating & Waterproofing company was represented by Mr. Callender in person, and some very handsome samples were exhibiled.

The Wainwright Manfg. Co., 65 Oliver street, Boston, exhibited a model of the Wainwright standard corrugated tube feed-water heater, samples of corrugated brass and copper tubing for electroliers and other ornamental purposes, condenser and heater tubes, boiler flues, etc., and samples of their corrugated copper tube expansion joints for steam pipes. They also displayed an application of their corrugated copper tubing in a coil, for a coil feed-water heater, this being but one of its many uses.

The E. P. Gleason Manfg. Co., of New York, had a tasteful exhibit of their ornamental glass and other work for electric light appliances. The many staple and special electric light appliances, several of which the company have furnished since 1880, have accumulated to such an extent that they thought it a good plan to exhibit samples of their arc and incandescent fittings in brass, tin, iron and glass at the convention, the object being to place before the electric light community either such goods as they call "staple" in connection with electric lighting, or to indicate where they may go to have something specially made according to their own notions and requirements.

The New England Wiring & Construction Co, of Boston, represented by S. B. Paine and W. J. Paine, had on view their multiple switch system for incandescent lighting, a large Bergmann electrolier and the "Regulator oil cup," especially adapted for high speed machinery. They further showed the Simplex arc lamp, for A. F. Mason, running on incandescent circuit.

A large number of incandescent lamps on the Slattery alternating system, shown in the convention hall and the executive committee rooms, were put in by the Sun Electric Co., of Boston.

The Sawyer-Man Electric Co. displayed one of their 50-light machines driven by a Baxter motor and lighting three handsome chandeliers. During the progress of the convention, by the foolish interference of some unknown person, two of the armatures of the ten-horse-power motor were burned out, necessitating the substitution of a four-horse-power motor. The Sawyer-Man

company were therefore forced to reduce the number of lamps on their machine to forty, which the four-horse motor carried very easily.

The Baxter Motor Co. made an extensive and interesting display of twelve motors, ranging in power from one-half to ten-horse-power. To the motors were attached exhaust fans, a cupola fan, printing presses, machines used in the manufacture of shoes, and also in the manufacture of shirts

The Thomson-Houston Electric Co. exhibit was very large and received the attention to which it was entitled. It comprised various appliances for running incandescent lights in series, or on arc circuits, motors, samples of welding and details of manufacture. Apparatus designed by Professor Elihu Thomson to illustrate alternating current phenomena was also shown. G. W. Davenport was in charge.

Chicago Electric Club.

There will be a meeting of the CHICAGO ELECTRIC CLUB, Monday evening, August 22nd, at 8 o'clock, at the rooms of the Club, 223 Dearborn Street.

DETROIT ELECTRICAL WORKS,

MANUFACTURERS OF

Electric Supplies

INCLUDING

Medical Batteries, Skeleton, Iron and Box Bells, Burglar Alarms, Hotel and House Annunciators, Fire Alarm Boxes, Pins and Brackets, Insulated, Magnet, Telephone and Electric Light Wire.

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Fisher's Electric Motors,

AND ALL APPLIANCES FOR CITY AND SUBURBAN

ELECTRIC RAILWAYS.

General Offices and Works, - - DETROIT, MICHIGAN.

SPRAGUE ELECTRIC RAILWAY & MOTOR CO.

OFFICES

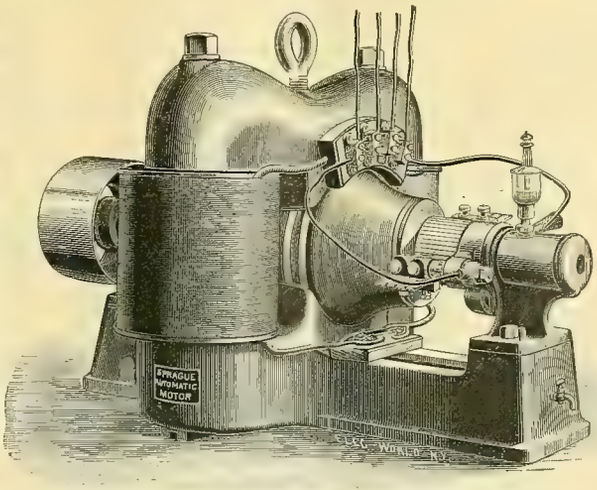
NEW YORK, 16 and 18 Broad Street.
BOSTON, 55 Oliver Street.
NEW ORLEANS, 20 Carondelet Street.
DETROIT, 133 Jefferson Avenue.
CHICAGO, 185 Dearborn Street.
ST. LOUIS, 304 Locust Street.
PHILADELPHIA, 119 South 4th Street.
CLEVELAND, O., 117 Public Square.

The Sprague Motors have been formally adopted for use on the Edison Circuits, and they are being introduced on these and also on Westinghouse, Brush-Swan, Thomson-Houston and United States Circuits, in New York, Chicago, Boston, Des Moines, Elgin, Oskaloosa, Pittsburgh, Chester, Williamsport, Lancaster, Shamokin, York, Detroit, Topeka, Cincinnati, Springfield, New Brunswick, Fall River, New Bedford, Milford, Taunton, Lawrence, Woonsocket, Fort Meyer, Waterbury, Annapolis, St. Louis, Abilene, Pawtucket, Syracuse, Canada, and the Argentine Republic, and have been shipped to Berlin and Milan.

This company has ample means to undertake any desirable contract for the tramsmission of power for any purpose, under suitable guarantees. The company is now possessed of the best facilities for manufacture of any motor company in the world. Arrangements have been made with the Edison Machine Works, to manufacture and carry in stock large numbers of standard machines, and a special factory —the only experimental factory devoted exclusively to that work in existence—has recently been started in New York, and is equipped with the finest tools that are made.

At present there are being operated in Boston seventy-five motors, varying from 1-2 to 25 horse-power.

This is the only company in the United States devoting its entire energies to the different questions involved in the transmission of power, and it is putting into practical use more motors of and over one-half horse-power than all other companies combined.



SPRAGUE AUTOMATIC MOTOR.—15 Horse-Power. 220 Volts. Efficiency, 91 per cent.

The Sprague Company are now also contracting for STREET RAILWAY WORK on an extended scale. They have just been awarded the largest street railway contract for electrical work ever given: the equipment of 12 miles of railway, with 40 street cars, requiring 80 motors of 7½ H. P. each. They have also contracted with the C., B. & Q. R. R. for transfer work at Aurora, Ill., selling the company both the motors and dynamos. One thousand motors are now being constructed at the factories for industrial and railway uses, aggregating nearly 4,000 horse-power.

Correspondence invited, and estimates furnished for complete Central Stations or Special Transmissions up to 1,000 horse-power, and for Street Railway Work.

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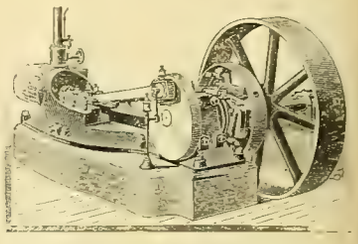

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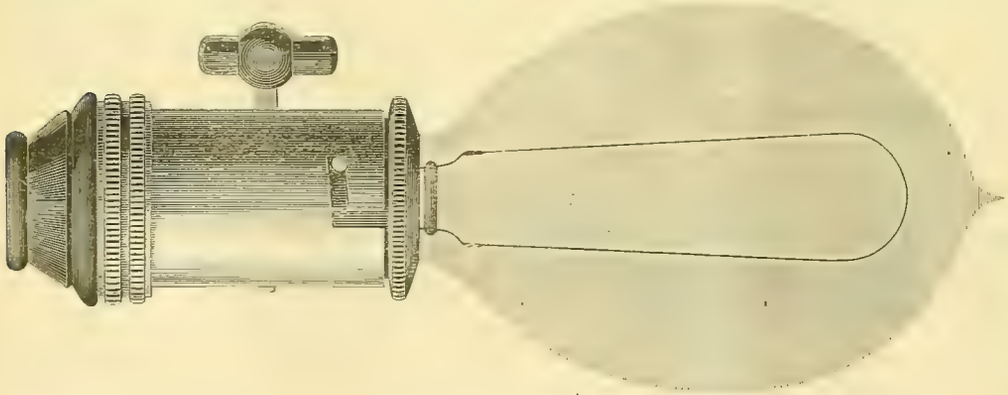

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We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

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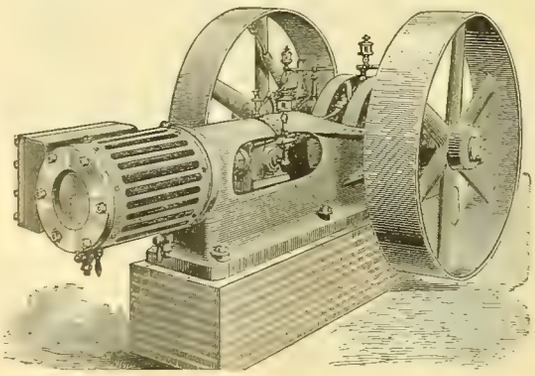

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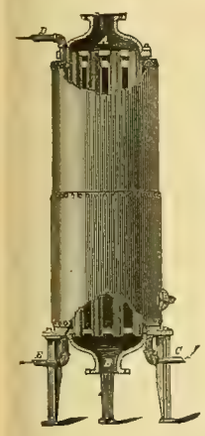

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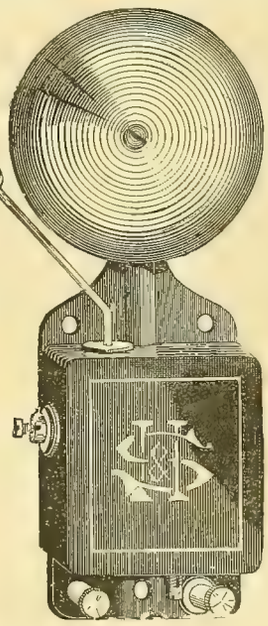

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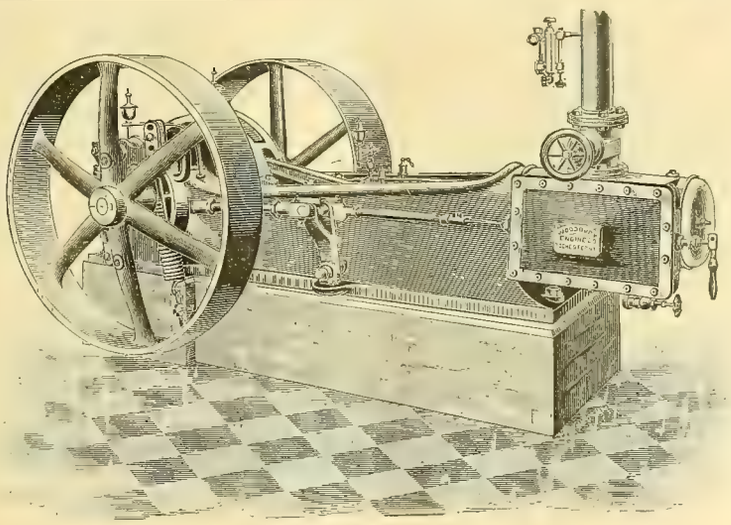

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Gentlemen: — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good time-keeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

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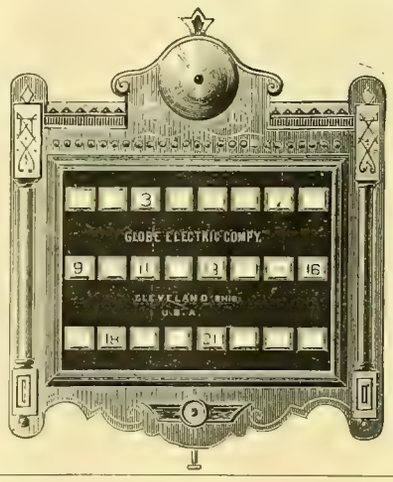

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12	"	29 00	80	"	132 00
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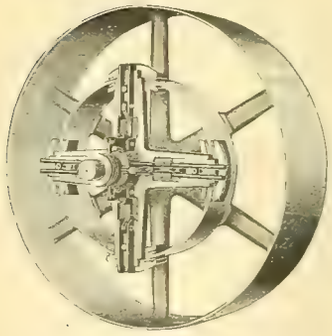

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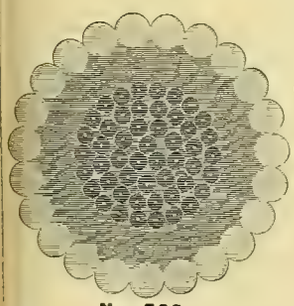

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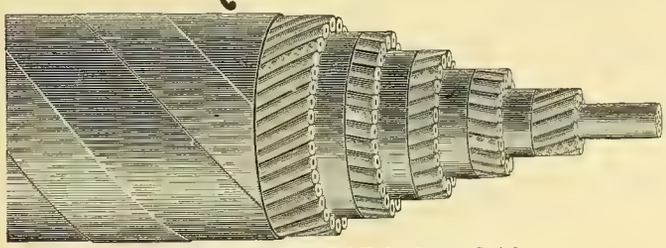

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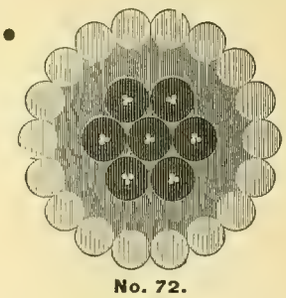

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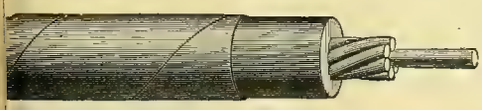
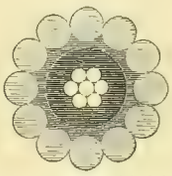


Underground Electric Light Wire.
6 No. 14 and 1 No. 13. Insulation, 16-32.



Armored Electric Light Cable.
6 No. 14 and 1 No. 13. Insulation, 16-32. Armor, 12 No. 6.

No. 6 Electric Light Wire.
Kerite Insulation and two Braids.

No. 18 Copper.
4-32 Insulation. Plain.

No. 16 Copper.
6-32 Insulation. Braided.

No. 18 Copper.
4-32 Insulation. Lead Encased.
FOR UNDERGROUND USE.

No. 20 Copper.
3-32 Insulation. Plain.

CLARK B. HOTCHKISS, General Manager, 16 Dey Street, NEW YORK.

THE ELECTRICAL SUPPLY COMPANY, 171 Randolph Street, Chicago, Ill. } Western Agents { THE WESTERN ELECTRIC COMPANY, Chicago, Ill.

The United States Electric Lighting Co.

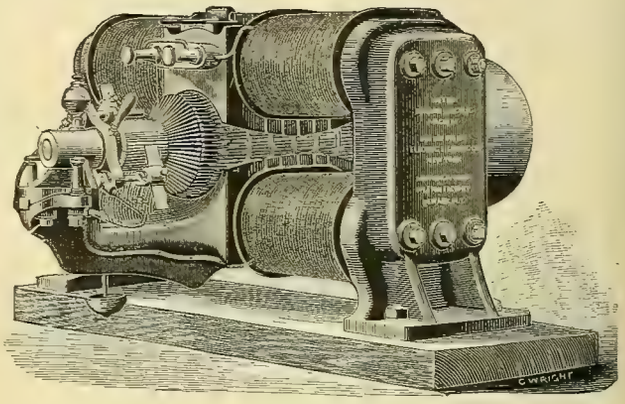
MANUFACTURERS OF

Incandescent and Arc Light Apparatus.

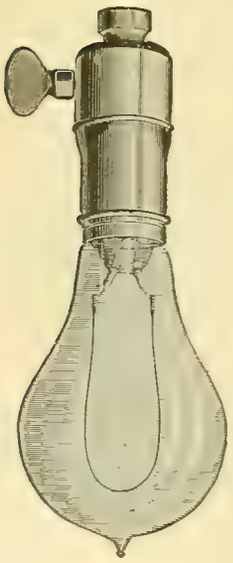
Claiming Superiority over other Systems

BECAUSE OF

Economy of Power.
Mechanical Design and Workmanship.
Perfection of Automatic Regulation.
Durability of Lamps.
Absence of Discoloration of the Lamp Globes.
Precision and Reliability of Measuring Instruments.
Completeness of Detail.



United • States • Long • Distance • Incandescent • Lighting.

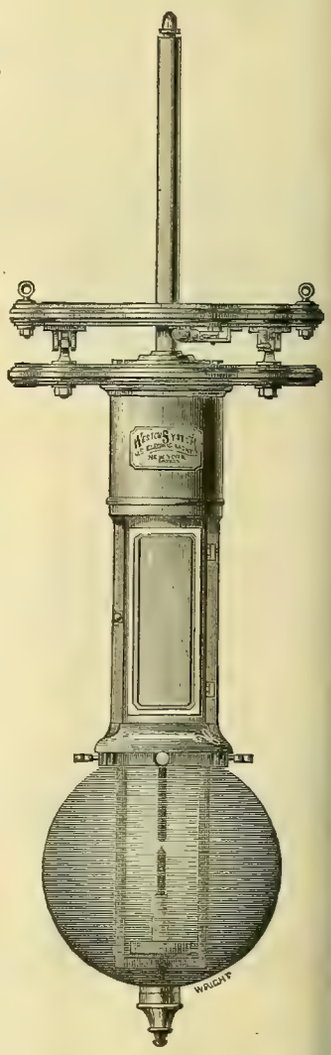


The only system offering reasonably low cost for main conductors combined with economy in operation, that has been subjected to a commercial test for any length of time.

ITS CLAIMS ARE

GREAT SIMPLICITY.
UNEQUALLED ECONOMY OF OPERATION.
UNEQUALLED ECONOMY IN COST OF MAINS.
THAT IT CAN BE DISTRIBUTED MORE WIDELY.
Greater COMMERCIAL SUCCESS than any other System Tested.

SEND FOR CATALOGUE AND TESTIMONIALS.



Compare our guarantees of the following SIX most important points in incandescent lighting with the guarantees of any other Company.

1st.	Number of 16 Candle Power Lamps to the Horse Power,	10
2nd.	" " 20 " " " " " "	8
3rd.	Life " 16 " " " guaranteed,	600 hours.
4th.	" " 20 " " " "	1000 "
5th.	Percentage of discoloration of lamps at or near end of guaranteed life,	inappreciable.
6th.	Self Regulation of Dynamos to insure even burning of Lamps,	yes.

C. C. WARREN,

MANAGER WESTERN DEPARTMENT.

216 La Salle Street, CHICAGO.

Territory:—Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Arkansas, Kansas, Nebraska Colorado, Dakota, Idaho, Montana, Utah, New Mexico, Texas, etc.

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JOSEPH A. SLEEPER, President
W. A. STILES, Secretary and Treasurer.

AARON K. STILES, Manager.
C. J. VAN DEPOELE, Electrician.

THE

Van Depoele Electric Manufacturing Co.

OF CHICAGO, ILL., U. S. A.

OWNERS OF THE PATENTS AND INVENTIONS OF CHAS. J. VAN DEPOELE.

FOR

ELECTRIC RAILWAY APPARATUS,

Electric Arc Light Dynamos and Lamps.

CONSTANT SPEED STATIONARY ELECTRIC MOTORS, ETC.

OUR

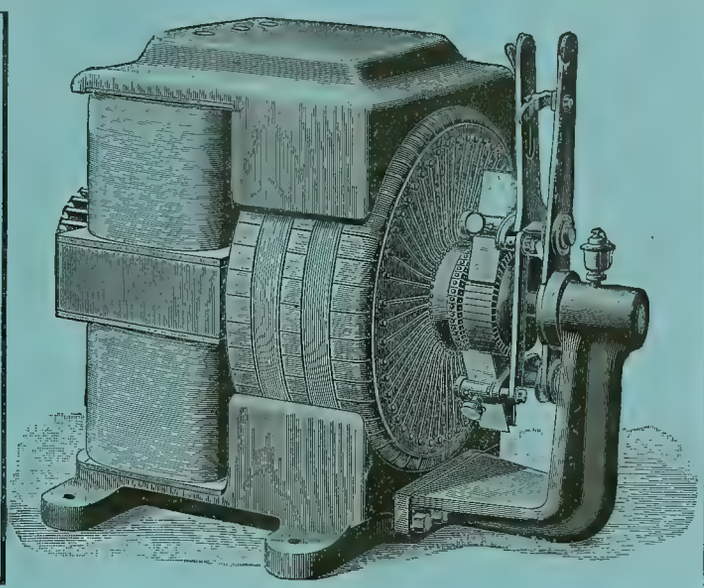
Arc Electric Light

UNEQUALED.

The Only Perfect Double-Lamp.

THOUSANDS IN USE.

Guaranteed equal to any in every respect.



OUR

Electric · Railway

SYSTEM

PROTECTED BY

BROAD ✻ PATENTS.

The Overhead Wire and Underground Conduit Systems Fully Protected.

Van Depoele Electric Railways

ARE IN OPERATION AT

Appleton, Wis., Scranton, Pa., Montgomery, Ala., Detroit and Port Huron, Mich., Windsor, Ont., Binghamton, N. Y., and Lima, O., and are being constructed at Ansonia, Ct., Brooklyn, N. Y., and St. Catharines, Ont.

ESTIMATES AND CATALOGUES SENT ON APPLICATION.

VAN DEPOELE ELECTRIC LIGHTS

Are in use everywhere and are daily growing in popularity.

WRITE FOR ILLUSTRATED ELECTRIC LIGHT CATALOGUE.

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OFFICERS:
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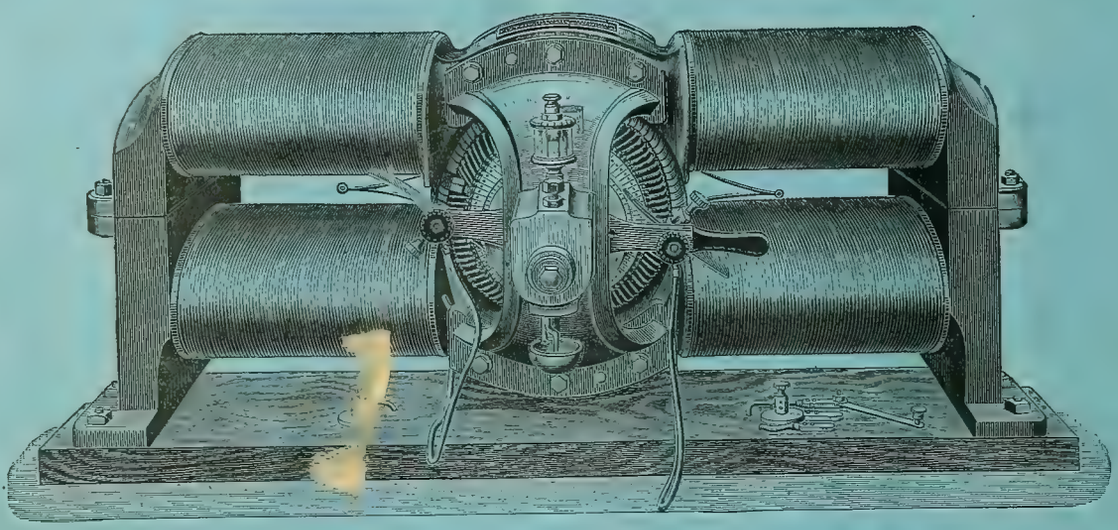
P. A. RANDALL, V. Prest. R. T. McDONALD, Treas. & Gen'l Manager.

DIRECTORS:
H. G. OLDS. JOHN H. BASS. P. A. RANDALL.
M. W. SIMONS. R. T. McDONALD.

Fort Wayne "Jenney" Electric Light Co.

SOLE OWNERS AND MANUFACTURERS OF THE

Main Office and Works:
Broadway and P. Ft. W. & C. Ry.
FORT WAYNE, IND., U. S. A.

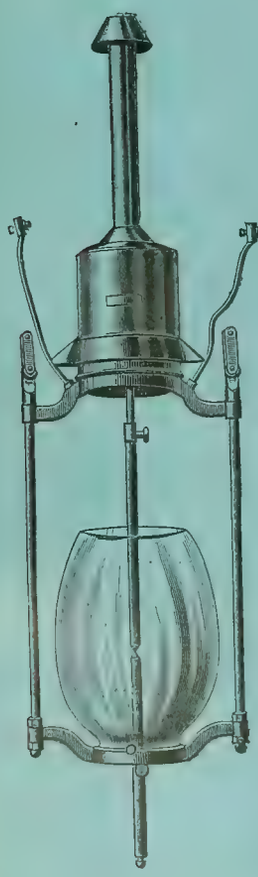


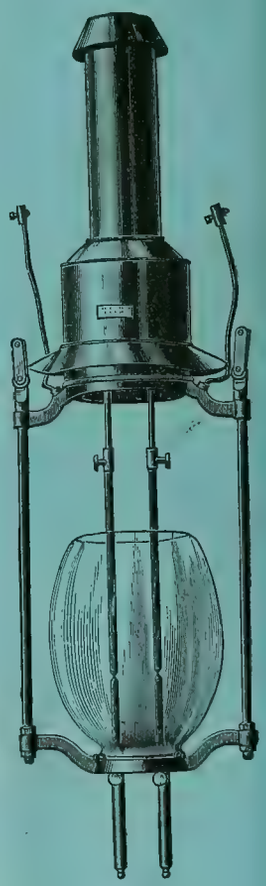
Branch Office:
115-117 Monroe Street, Chicago.
W. J. BUCKLEY, Manager.

J. A. Jenney Dynamo-Electric Machines

—AND THE—

Perfectly Automatic and Self-Regulating





JENNEY ARC LIGHT

The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

ONLY GOLD MEDAL

At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

This system HAS NO EQUAL for SIMPLICITY, DURABILITY and STRENGTH OF LIGHT.

—ALSO—

COMPLETE INCANDESCENT SYSTEM.

DYNAMO: PERFECTLY AUTOMATIC, SHUNT WOUND, REQUIRING NO RESISTANCE for variable load.

LAMP: NEW FILAMENT, NEW PRINCIPLE of Construction, REMARKABLE LENGTH OF LIFE with FULL CANDLE POWER, will not deposit carbon on inner surface of bulb.

The filament is as pliable as a piece of thread and is not made brittle by the action of the current.

Complete System of Fixtures and Attachments, also full line of Electroliers, Combination Fixtures and Shades.

We are in the market for Large Incandescent Contracts.

ELECTRIC MOTORS

We have the Only Perfect Working Headlight for Steamboats, with Focusing Reflector. Full information furnished on application.

Philadelphia Office: 26 North Seventh Street. G. A. WILBUR, Manager.

Western Electrician.

EVERY SATURDAY.

Vol. I. CHICAGO, AUGUST 27, 1887. No.

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Russell & Co.

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BUILDERS OF

AUTOMATIC ENGINES

BOILERS, ETC.

Complete Power Plants Furnished and Erected.

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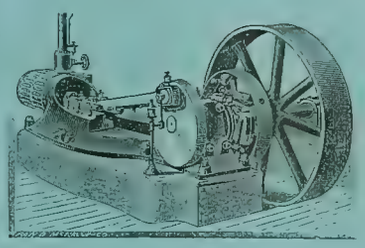

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ELECTRICAL EXPERT.

DEALER IN Electrical Securities. | EXPLOITER OF Electrical Inventions.

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The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling. All Sizes *Lead Encased Wires.* Aerial Use, Subterranean Use, Submarine Use, Concealed Wiring in all Locations.

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THE NATIONAL CARBON CO.

CLEVELAND, OHIO,

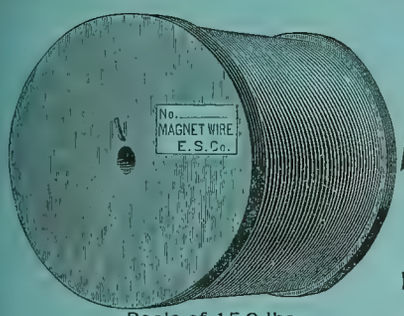
MANUFACTURERS OF

ELECTRIC LIGHT CARBONS

AND

BATTERY MATERIAL.

ELECTRIC LIGHT SUPPLIES.



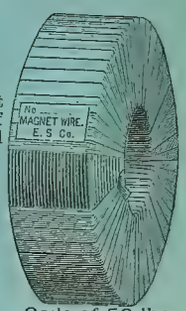
Reels of 150 lbs.

Magnet Wire—We make a specialty of furnishing Magnet Wire of an exact outside diameter, and any orders sent us, giving diameter of bare wire and outside diameter in thousandths of an inch, will be filled precisely as specified.

THE ELECTRICAL SUPPLY CO.

Factories, Ansonia, Conn. No. 171 Randolph St., CHICAGO.

17 Dey Street, NEW YORK.



Coils of 50 lbs

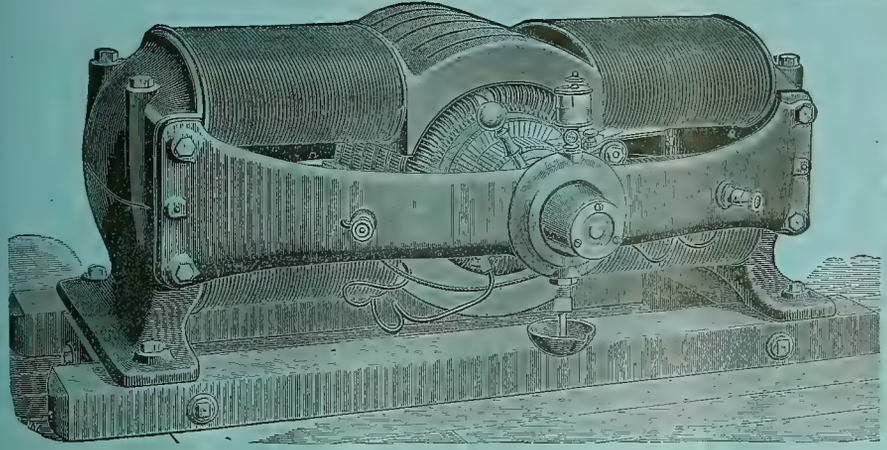
DANIEL W. MARMON, President.
ADDISON H. NORDYKE, Vice-President.

CHARLES D. JENNEY, Electrician

BRAINARD RORISON, Secretary.
AMOS K. HOLLOWELL, Treasurer.

JENNEY ELECTRIC COMPANY,

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

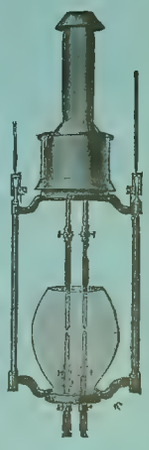
The Jenney Arc-Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

Cor. Kentucky Ave. and Morris St. Indianapolis, Ind.



The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

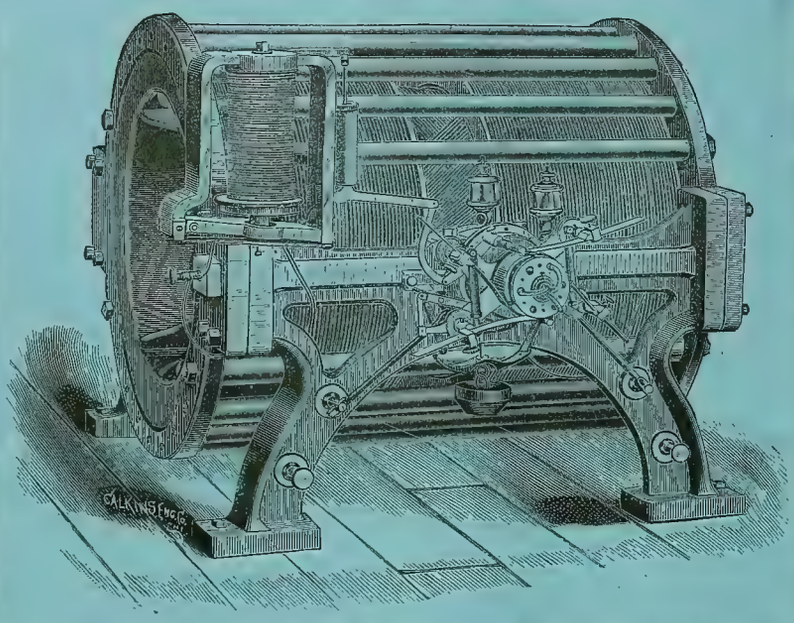
OF

Electric Arc-Lighting

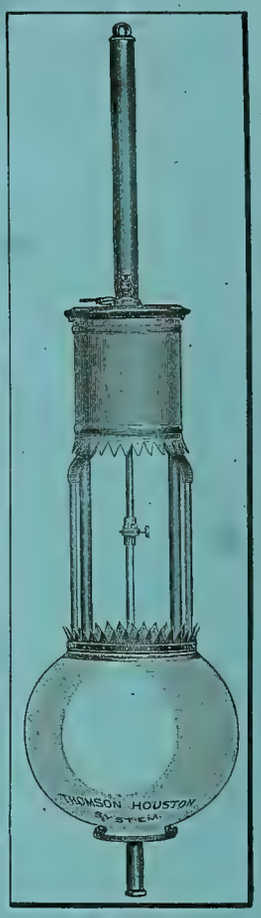
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

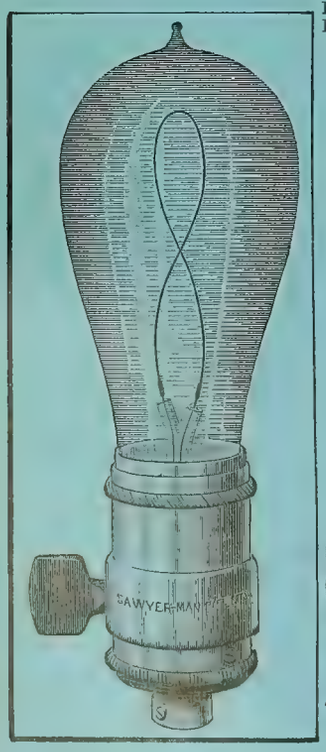


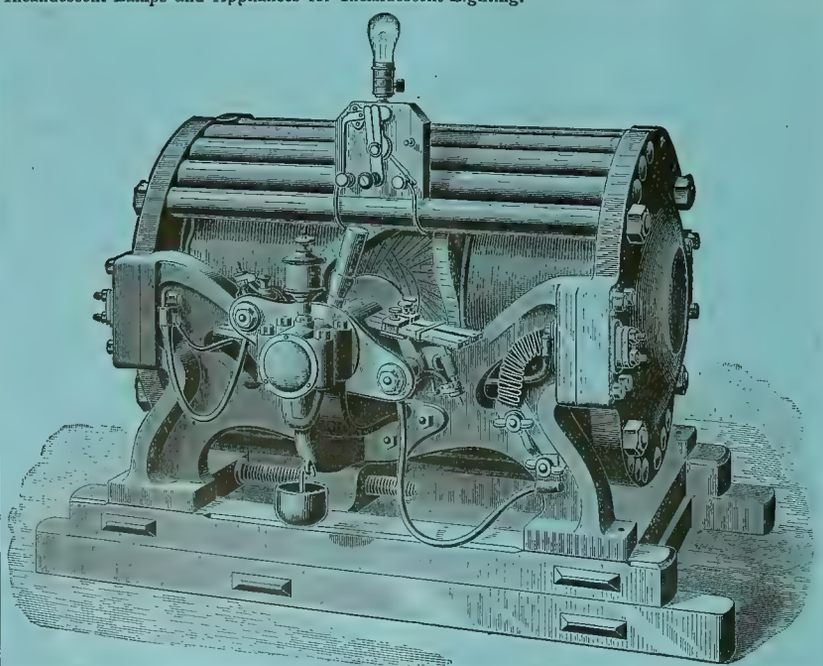
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT **LONG DISTANCE INCANDESCENT LIGHTING.**

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

K. M. JARVIS, President. J. A. GRANT, Secretary. A. F. UPTON, Treasurer and General Manager.

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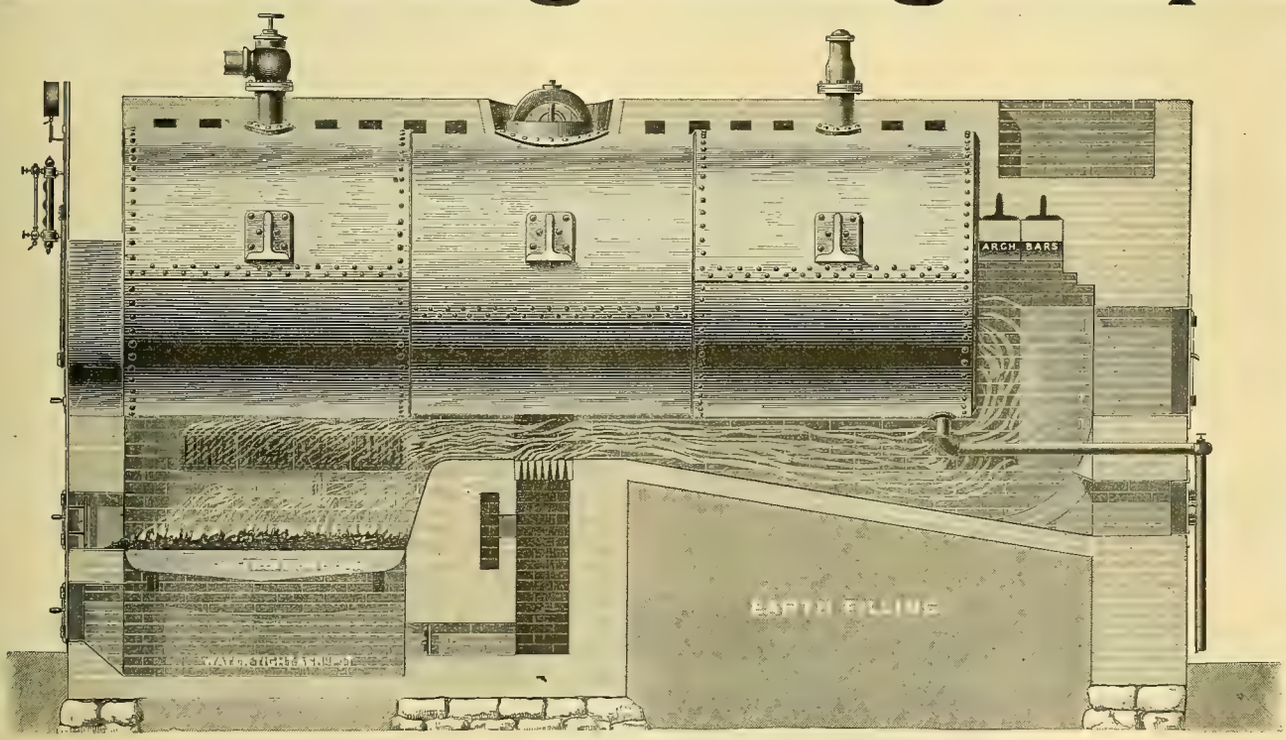
Engineers and Contractors.



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Burns Slack, Screenings, Coke, Breeze, etc. Correspondence solicited. Circulars, Catalogues, and general information furnished on application.

ARE PREPARED TO FURNISH ESTIMATES AND CONTRACT FOR

COMPLETE OUTFITS OF STEAM MOTIVE POWER

For Electric Lighting Stations, Mills and Factories, including Boilers, Engines, Steam Pumps, Feed Water Heaters, Injectors, Iron Stacks, Grate Bars, Boiler Furnaces, etc.

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BOSTON: No. 61 Oliver St. H. A. GLASIER, Mgr. Western Department. NEW YORK: No. 108 Liberty St.

REYNOLDS' IMPROVED CORLISS.

THE IDEAL ENGINE FOR ELECTRIC LIGHT WORK.

Unequaled for Close Regulation

—AND—

ECONOMY OF FUEL.

Write for our Catalogue and Circular giving List of Users.

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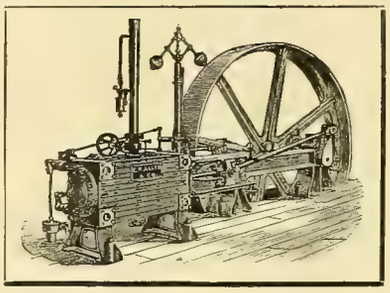

We refer to the following electric light plants now using the Reynolds' Corliss:
Brush Electric Light and Power Co., Cleveland, O.
Edison Electric Light and Power Co., Rockford, Ill.
Syracuse Electric Light Co., Syracuse, N. Y.
Louisiana Electric Light and Power Co., New Orleans, La., three engines.
Badger Illuminating Co., Milwaukee, Wis., two engines.
West Side Power Co., Minneapolis, Minn., four engines.
Louisville Electric Light Co., Louisville, Ky.
La Crosse Brush Electric Light and Power Co., La Crosse, Wis.
C., M. & St. P. R. R., Milwaukee, Wis.
Menominee Mining Co., Iron Mountain, Mich.
West Hotel, Minneapolis, Minn.
Plankinton House, Milwaukee, Wis.
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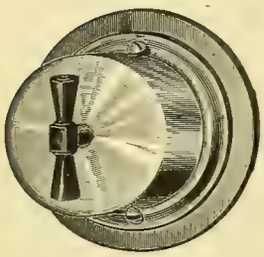
J. V. Farwell & Co., Chicago, Ill.
Chas. H. Slack, Chicago, Ill.
Mandel Brothers, Chicago, Ill.
C. Boetcher, Leadville, Col.
Omaha Thomson Houston Electric Light Co., Omaha, Neb.
Thomson-Houston Electric Co., Racine, Wis.
Sioux Falls Electric Light and Power Co., Sioux Falls, Dakota.
Electric and Water Supply Co., Neillsville, Wis

EDW. P. ALLIS & CO., RELIANCE WORKS, MILWAUKEE, WIS.

CHICAGO BRANCH: 48 South Canal Street.

FOREST CITY ELECTRIC WORKS,

MANUFACTURERS OF

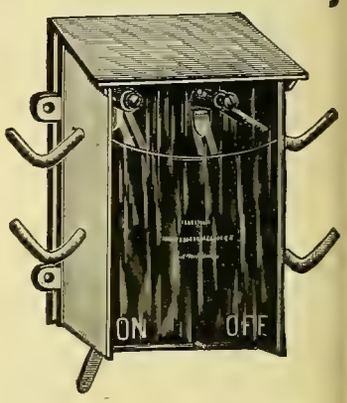


Cleveland's Electric Light Cut-outs,

GANG SWITCHES, FROM 5 TO 40 AMPORES.

Quick Make and Break Uncontrolled by the Handle.

Correspondence Solicited with Electric Light Companies.



W. B. CLEVELAND, Proprietor,

26 S. WATER STREET, CLEVELAND, O.

FARADAY CARBON COMPANY, LIMITED

CAPACITY, 1,000,000 CARBONS MONTHLY

QUALITY GUARANTEED EQUAL TO ANY IN THE MARKET.

LOW PRICE LIBERAL DISCOUNT ON LARGE ORDERS. CORRESPONDENCE SOLICITED.

PITTSBURGH, PA.

NEW ❋ YORK ❋ SAFETY ❋ STEAM ❋ POWER ❋ CO

BUILDERS OF HIGH GRADE SELF-CONTAINED

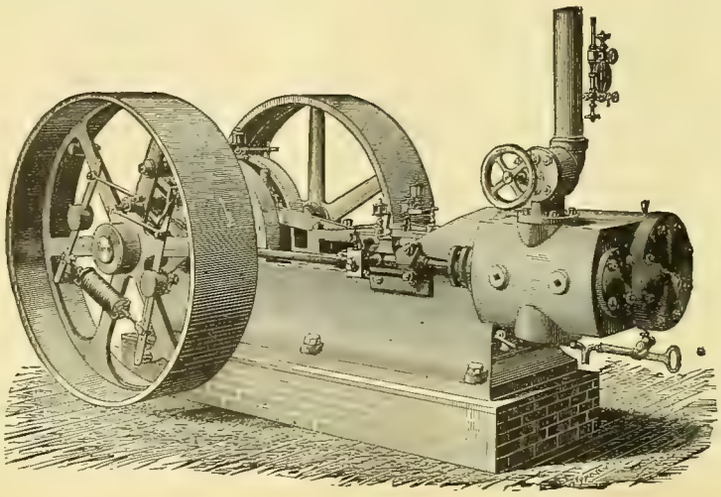
AUTOMATIC

Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC ❋ LIGHTS

And other duty requiring close regulation of speed.



ADVANTAGES:

Great strength without excessive weigh
Small space required.
Simplicity of construction.
Accessibility of all part

ESTIMATES CHEERFULLY FURNISHE

Western Office and Warerooms:

64 & 66 S. CANAL ST

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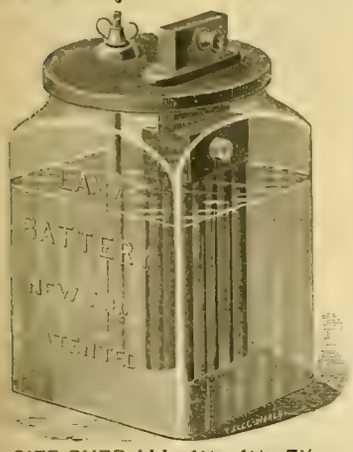
WM. A. HAMMETT, Mg

THE IMPROVED "LAW PRISM" BATTERY



SIZE OVER ALL, 4¼ x 4¼ x 7½.

THE NEATEST OF ALL BATTERIES. THE BEST AND CHEAPEST.

With the exception of glass broken by carelessness, and the zinc and salammoniac consumed in the production of current, **all parts of this Battery are Guaranteed** to be **Everlasting.** Perfectly **uniform** and **reliable** in action, of **faultless construction** and **beautiful appearance.**

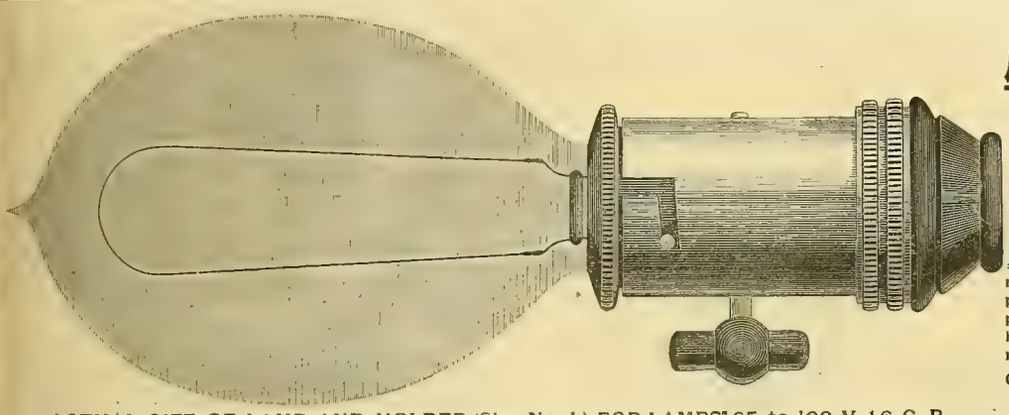
PERPETUAL NEGATIVE ELEMENTS!!!

These consisting of specially prepared prisms of Carbon are fine depolarizers, performing this function indefinitely, **do not require renewal,** as is the case where chemical depolarizers are employed, thus a **great economy** is effected. These cells are so constructed as to prevent evaporation of the solution, and crawling out of the salts. Thousands of these cells now employed for **Telephone Transmitters, Gas Lighting, Annunciators, Burglar Alarms** and other **Automatic Devices** are giving **Perfect Satisfaction.**

The many Physicians now using the "**Improved Law**" as an office battery, are unanimous in their expressions as to its perfection and adaptability for electrolysis and general galvanization, requiring no renewal nor attention in from two to five years, the latter depending only on the amount of use.

Note:—This battery is not suitable for Galvano Cautery nor Incandescent Light purposes.

LAW TELEPHONE CO., Sole Manufacturers, 112 LIBERTY ST., NEW YORK.



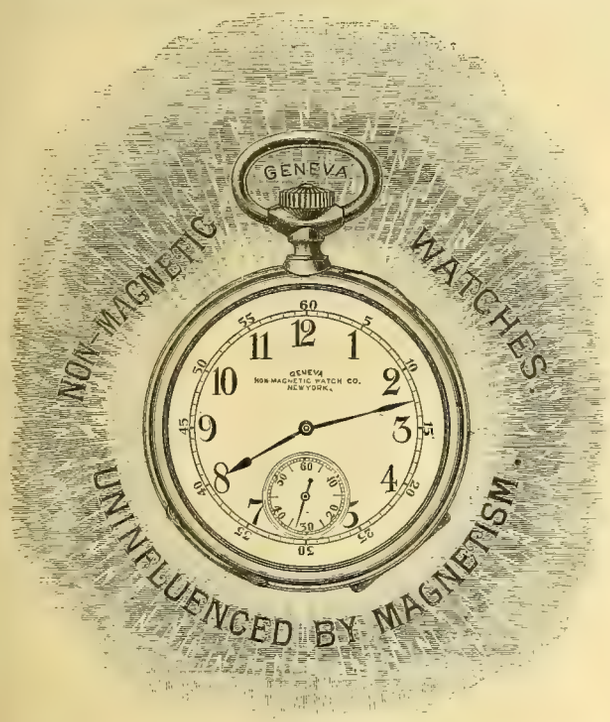
ACTUAL SIZE OF LAMP AND HOLDER (Size No. 1,) FOR LAMPS 65 to 100 V. 16 C. P.

Aluminous Incandescent.

We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

CORRESPONDENCE REQUESTED.
CATALOGUES ON APPLICATION.

VITRITE & LUMINOID CO., 182 FULTON ST., NEW YORK.



Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode. Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the *works*, they require no shield or other protection.

Ask your jeweler for them, Send for Catalogue.

Geneva Non-Magnetic Watch Co., L'd.

177 and 179 Broadway, NEW YORK.

Central Electric Company,

M. T. GREENE, President.
GEO. A. McKINLOCK, Treas.
WM. H. McKINLOCK, Secy.

38 and 40 La Salle Street, Chicago.

MAGNET
OFFICE
ANNUNCIATOR
UNDERWRITERS
LINE
BARE COPPER
} WIRE.

ELECTRIC BELLS,
BURGLAR ALARMS,
HOTEL ANNUNCIATORS.

PRICES ON APPLICATION.

Telegraph, Telephone and Electric Light Supplies.

ANNUNCIATORS, BURGLAR ALARMS, ELECTRIC BELLS, BATTERIES AND BATTERY SUPPLIES.

Repair Work done and Special Manufacturing attended to. Skilled Workmen in all Departments.

☞ ALL APPARATUS WARRANTED AND SATISFACTION GUARANTEED.

MAGNETO BELLS, ETC., ETC.

Railway Telegraph Supply Company,

No. 211 and 213 Randolph Street, CHICAGO.

CORRESPONDENCE SOLICITED.

Patterson Weather-Proof Electric Light Wire,

The best Fire and Weather-Proof Electric Light Wire in the Market.

The price is not greatly in excess of that for the ordinary UNDERWRITERS' ELECTRIC LIGHT WIRE.
Send for price list of this wire.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

THE PARKER-RUSSELL MINING AND MFG. CO.

Electric Light Carbons

CITY OFFICE,
711 PINE STREET,
ST. LOUIS, MO.

ADAPTED TO ALL SYSTEMS.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT,
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously installed by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 500 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C C Warren Esq.
Dear Sir, I have written the answers opposite your questions above as per your request, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.
Yours truly, J. F. Conklin

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

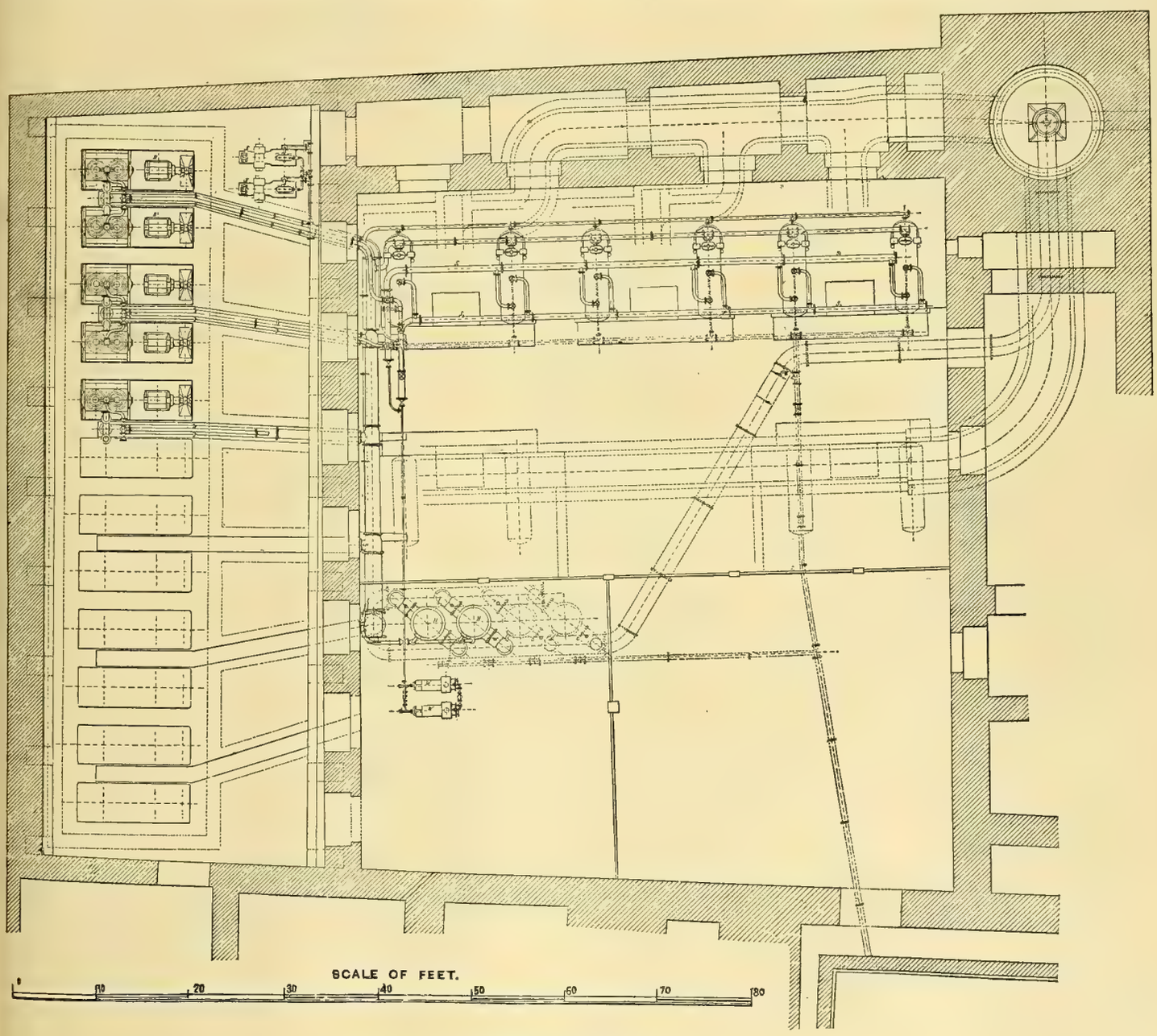
Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, AUGUST 27, 1887. No. 9.

Vienna Central Lighting Station.

After the burning of the Ring theater in Vienna, and the deplorable loss of life resulting therefrom, the emperor of Austria, who has always taken a personal interest in questions of public welfare, determined to remove at least one source of danger by insisting that in future all large theaters should be electrically lighted, and he gave orders to that effect to the managers of those theaters which are immediately under court control. Eventually instructions were given to the Imperial Continental Gas association who have the sole contract for lighting the town by gas—to install the electric light in the two principal theaters. The association purchased the large house formerly occupied by the English embassy, and now have their central lighting station plant established. The general scheme, as will be noted in the illustration, comprises the use of large direct driven steam dynamos. The court-yard, in which the plant has been placed, has been excavated to a depth of 15 feet 6 inches below the street level, and the part most remote from the street has been made into a boiler-room. The building itself is utilized, partly for offices and partly as a large dynamo and engine room. The boiler-room has been roofed over with a glass and iron lean-to, the front of which is 11 feet 6 inches above the ground level, so that the total height of the boiler-room is 27 feet. The front portion of the court-yard is partly utilized as a store-room for fuel. It has been covered over and asphalted at the ground level, so that the coke wagons can go in through the main entrance and deliver the coke into the space below through chutes provided for the purpose. The rest of the space to the left in the illustration is reserved for feed-pumps, water heating and purifying apparatus. In the plan, the heaters are shown at H H, and the pumps at W W. Space has been provided in the boiler-room for ten boilers, six of which are already in position. These boilers are of the kind known as Captain Scott's patent, having a cylindrical shell, a flat-sided water leg below, and an egg-shaped steam reservoir above. The



Vienna Central Lighting Station.

water leg below each boiler is placed between the two furnaces. The products of combustion pass along this water leg and beneath the shell to the back tube plate, returning through the tubes to the front end, and into an iron smoke box common to a pair of boilers. From these smoke boxes the gases are led through downtakes placed midway between each pair of boilers to a system of underground flues indicated in the illustration by dotted lines, and into the base of the chimney. The exhaust steam is also taken into the chimney, but as it would cool the products of combu tion and impair the draught if this steam were discharged at the bottom, the exhaust pipe is carried centrally up the chimney almost to the top, so as to afford an outlet for the exhaust just below the ornamental spark catcher. The chimney is a cylindrical shaft 150 feet high, and 8 feet 6 inches internal diameter. Each of the six boilers is capable of evaporating 400 gallons of water per hour when the furnaces are fired with small refuse coke from the gas works, which will probably be the fuel usually employed. The boilers are fed by water from a well sunk on the premises. The water is pumped into tanks, and provision has been made to purify it by forcing it through Clark's combined feed water heaters and filters, two of which are already installed, while room is provided for two more. The pipe connections are arranged in such a manner that the exhaust steam may be sent either through these feed water heaters and then to the chimney or direct to the latter. The feed water is forced into the boilers by a pair of Worthington high pressure pumps.

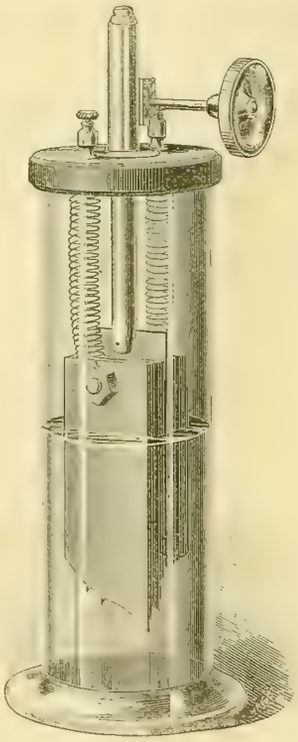
A remarkable feature in this installation is that the steam and water connections are in duplicate, this precaution having been taken in order to remove all possibility of a stoppage in the supply of electricity consequent upon the accidental bursting of a pipe. The steam reservoir on each boiler is provided with two stop valves, and two steam pipes, branching out in opposite directions, and joining the main steam pipes. Each set of pipes is large enough to supply the whole of the steam required, and should a pipe burst in one system it is only necessary to close all the stop valves on this and open those of the other system. The boiler-house being at a sufficiently low level it was possible to arrange all the steam pipes with a sufficient incline, so that the condensed water should by gravity drain back into the boilers.

The engine and dynamo room is situated to the left of the main entrance, and is 78 feet long, 29 feet wide, and 18 feet 4 inches high. For the convenience of erection and repair of the machinery it has been fitted with an overhead traveler running from end to end. Provision has been made for twelve combined sets of main engines and dynamos, and a corresponding number of exciting machines. The dynamos are of the vertical Crompton type with double horse shoe magnets, and they are driven direct by Willans' compound central valve engines. Five of these sets have already been fixed, and the rest will be installed as the demand for current increases. The engines are of modern type, the peculiar feature being the central valve worked from an eccentric on the crank pin, by which a very quick cut-off is obtained. The engines are single acting compound, with the high pressure cylinder above the low pressure. At the lower end of the piston rod is a conical air piston, and at each upstroke a certain quantity of air is compressed, by which means the moving parts are brought to rest without entirely removing the pressure between the connecting rod and crank pin.

Each dynamo is designed to give an output of 72 kilo-watts, or 120 ampères at 600 volts pressure. The armatures are 36 inches long, and are supported in a bearing at the commutator end, while the other end of the dynamo spindle is bolted solid to the crank shaft of the engine by a steel coupling. The end bearing of the engine shaft has therefore to support a portion of the weight of the armature. The field magnets are divided at the center line of the armature, so that the top half can be lifted off by the traveller. This facilitates examination of the armature without removing it from the machine, and should it become necessary to remove it for further examination or repair this can be done by simply lifting it out by means of the traveller. The engines are provided with centrifugal governors, and with Willans' electric governors wound for constant current. The field magnets are separately excited, two small sets of combined engines and dynamos being provided for this purpose. In order to avoid the risk of a discontinuance of supply in case of a breakdown of any one of the exciting machines, accumulators have been installed and connected in parallel with the exciting dynamos. These accumulators are in themselves sufficient to supply the exciting current required by the dynamos for several hours, thus giving ample time to effect some small repairs, or to set a spare exciting machine to work in case of a breakdown. The current from the large dynamos is conveyed to a main switch board of the plug type, which is so arranged that any one of the machines can be coupled to any one of the five main circuits which will eventually branch out from the station. At present only two main circuits have been laid, but three more are in hand.

Bailey Current Regulator.

The accompanying illustration represents the new Bailey current regulator of the Law Telephone company's make. It is, in fact, a water rheostat in which a system of carefully prepared carbon plates, pointed and tipped with pointed sponges—the latter not being shown in the cut—are made to enter water, more or less immersion



determining the current strength, and their movement being effected by means of a fine rack and pinion adjustment. The range of resistance obtained is from about 2,000,000 down to 20 ohms. Changes in the strength of current are made without any possibility of breaks in the circuit. The carbon plates and sponges being perfectly inert, there is no corrosion due to electrolysis. The instrument, though simple, is well constructed, and is in no way liable to derangement. There is an element of economy in employing the current regulator with a battery from which varying current strengths are required, as all the cells are employed at once, thus maintaining absolute equality among them, renewal not being necessary until the whole battery needs it. This instrument is intended for physicians' use, instead of a switch-board or cell selector. With it there is no possibility of the patient receiving the sudden shocks due to disruption of circuit. It has been received with favor among leading physicians, doing all that is claimed for it, and giving perfect satisfaction.

Edison's Pyro-Magnetic Dynamo.

At the recent meeting of the American Association for the Advancement of Science, before the Physics section, Professor Baker, of the University of Pennsylvania read a paper prepared by Thomas A. Edison, describing a machine for producing electricity direct from fuel. To do this, says the paper, has long occupied the close attention of inventors. Could the enormous energy latent in coal be made to appear as electric energy, with reasonable economy, the mechanical methods of the entire world would be revolutionized and another grand step of progress would be taken.

Quite recently Lord Rayleigh concluded that from a copper iron couple a conversion of not more than one three-hundredths of the coal energy could be hoped. As a heat engine, therefore, the thermo cell can have no higher efficiency than Carnot's reversible engine. Another line of investigation suggested itself to Mr. Edison. It has long been known that the magnetism of metals is markedly affected by heat. Nickel loses its power of being magnetized at 400°, iron at a cherry-red heat, and cobalt at a white heat. Whenever a magnetic field varies in strength in the vicinity of a conductor a current is generated in that conductor; so it occurred to him that by placing an iron core in a magnetic circuit and by varying the magnetizability of that core by varying its temperature, it would be possible to generate a current in a coil of wire surrounding the core. This idea constituted the essential features of the new generator, which therefore he calls a "pyro-magnetic generator of electricity."

The principle was first applied to the construction of a simple form of electric engine, a "pyro-magnetic motor." This consisted of a permanent magnet, having a bundle of small tubes made of thin iron placed between its poles, and capable of rotation about an axis perpendicular to the plane of the magnet. By suitable means hot air passes through these tubes, so as to raise them to redness. By a flat screen placed across this bundle of tubes, and covering half of them, access of the heated air to those tubes is prevented. When this screen is so adjusted that its ends are equidistant from the two legs of the magnet, the bundle of tubes will not rotate, since the cooler and magnetic portions beneath the screen will be equidistant from the poles. If the screen be turned about the axis of rotation, so that one of its ends is nearer one of the poles and the other, nearer the other, then rotation of the bundle will ensue. The first motor constructed on this principle was heated by means of two small Bunsen burners, and it developed about 700 foot pounds a minute. A second and larger motor is now about finished, which will weigh about 1,500 pounds, and is expected to develop about three horse power. In both these machines electro magnets are used in place of permanent magnets, the current to energize them being derived from an external source. In the larger machine the air for combustion is first forced through the tubes to cool them, and then is forced into the furnace at a high temperature.

The construction of a machine of sufficient size to demonstrate the feasibility of producing continuous currents on a large scale was at once begun and has just been completed. The new machine consists of eight elements, each the equivalent of the device already described, arranged radially around a common center. The machine is placed upon the top of any suitable furnace, fed by a blast, so that the products of combustion are forced up through the armature in turn. The potential differer ce developed by this dynamo depends upon the number of turns of wire on the armature coils, the temperature difference in working, the rate of temperature variation, and the proximity of the maximum point of effect. The results thus far obtained lead to the conclusion that the economy of production of electric energy from fuel by the pyro-magnetic dynamo will be at least equal to and probably greater than that of any of the methods in present use. But the actual output of the dynamo would be less than that of an ordinary dynamo of the same weight. Since, however, the new dynamo will not interfere with using the excess of energy of the coal for warming the house itself, and since there is no attendance required to keep it running, it would seem to have already a large field of usefulness for it. By using the regenerative principle in connection with it great improvement may be made in its capacity.

The Cardew and Evershed Voltmeters.

On this page are shown illustrations of two voltmeters—one the Cardew, the other the Evershed gravity voltmeter, which are sold by the Vitrite & Luminoid company. The former voltmeter is now being manufactured in this country. It is claimed for this instrument that it is equally serviceable for direct and alternating currents, that it is perfectly constant and never requires recalibration, that it can be kept in circuit continuously, that it can be safely used close to the most powerful dynamo as it has no magnets or coils, that it has no self-induction and requires no correction co-efficient for the earth's magnetism, and that it is quite dead-beat and instantly responsive to trifling changes of current.

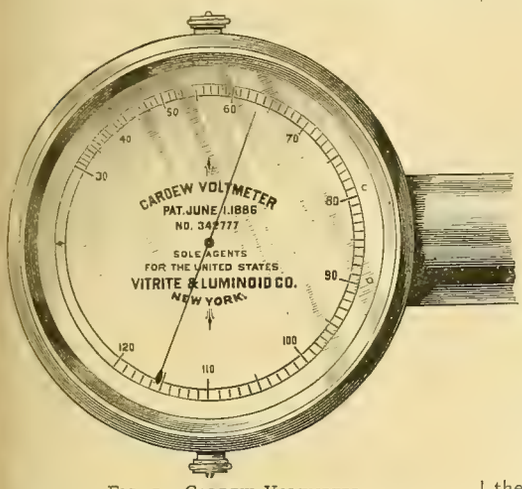


Fig. 1. Cardew Voltmeter.

Fig. 1 shows the face of the instrument and its reading, and Fig. 2 the general features of construction.

In this voltmeter a fine platinum-silver wire is heated by the current and its expansion measured. The wire *a*, *a*, is stretched inside a long tube. It starts from t^1, which is connected with one terminal, and is stretched along the inside of the tube and passes over a small ivory pulley and returns to *i*, which is connected with the spring J. After passing over the ivory pulley, *i*, it is led to the other end of the tube again, over another pulley and back to t^2. There are thus four lengths of the wires in the tube. The ivory pulleys at the end of the tube are attached to a casting which is fixed on the ends of two rods. This arrangement is to enable the wire to be threaded easily, as the tube or outer case can be removed without interfering with the adjustment of the wire. The wire is doubled backward and forward to get a greater length, and thus a higher resistance. As far as the expansion is concerned it is that of two lengths of wire, and the pull of the spring, J, is against two thicknesses of wire. The pulleys at the end of the tube are made to run with very little friction, and are carefully pivoted in jewel holes. The friction of the pulley, *i*, is not so important as that the expansion of the two loops of wire should be the same; *i* is attached to the wire, *d*, which is wound round a pulley, *w*, which is turned with two grooves. The wire passes from one groove into the other between two screws, as shown in the side view of the pulley. This prevents the wire slipping relatively to *w*. It passes on to the spring, J. The spring, J, is simply to keep the wire *a*, *a*, taut. The readings do not all depend on the strength of the spring, as it is too weak to be able to stretch the wire in the least. A little toothed wheel is attached to the pulley, *w*, and gears into the pinion, *P*, to which the index is attached. The wire for this type for 120 volts is .0025 inches in diameter, and is of platinum silver; the resistance is about 30 ohms per foot. This instrument takes 40 watts at 120 volts. Though this is high it must be remembered that this voltmeter has no temperature errors like those of electro-magnetic instruments. The temperature of the wire is in practice about 200° C. at the higher readings. The reading evidently does not depend on the absolute expansion of the wire, but on the relative expansion of the wire and bars. The bars are therefore made of steel for part of their length and brass the rest, so that they have the same coefficient of expansion as the wire. If it were not for this, the instrument if set to zero at one temperature would not come to zero at another. Though the instrument is compensated for temperature as regards the lengths of the rods and wire, there is another source of small errors; That is the rise of resistance of the wire when the voltmeter is used in a very hot room, or it falls if the room is too cold. If it is known beforehand that the instrument is going to be used, for instance, in an engine room at say 80°, it can be calibrated for use at that temperature. As the zero is apt to be altered by rough usage or shaking, the end of the wire, t^2, is attached to an adjusting screw, so that the little wire can be taken in or let out without interfering with the rest of the instrument. The object of using the rods to support the wire is to overcome the difficulties of stringing the wires, and of taking the voltmeter to pieces to examine or repair it without necessitating recalibration; but, as explained, they cause a small error. A short piece of very fine wire is put in circuit to act as a fusible cut-out, as a sudden and excessive rise of temperature might fuse both wires. The whole mechanism is fixed to a brass framework, B, B.

Fig. 3 represents the Evershed gravity voltmeter, a very neat and portable instrument. It is constructed of solid metal throughout. The base has leveling screws and spirit-level, so that accuracy may be easily secured. These instruments are purely electro-magnetic, the deflection being produced against the force of gravity by a very small and light soft iron bar drawn in between a pair of poles of peculiar form, by special shaping of which the instruments may be made, when desired, to give wide readings at any particular portion of the range. In the cut shown the readings are made to be specially wide between 50 and 60 volts. These instruments are calibrated once for all in the factory, and the scale is engraved for each instrument specially. They never need recalibration, as they have no permanent magnet or steel in them.

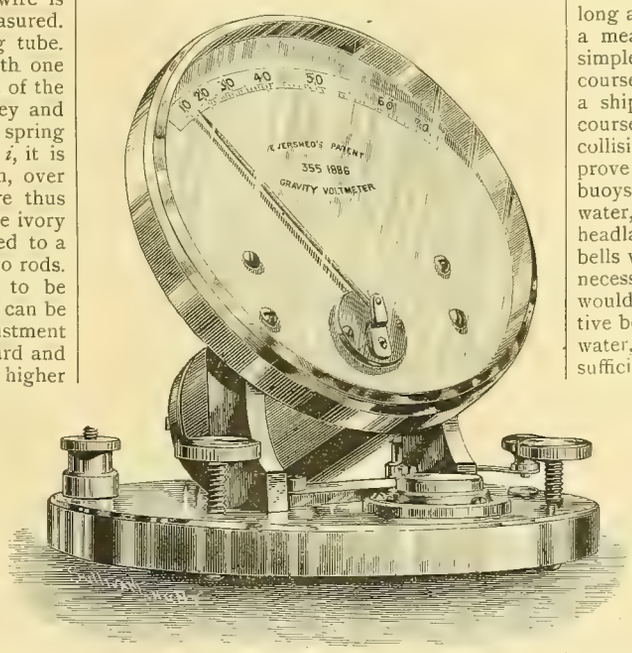


Fig. 3. Evershed Gravity Voltmeter.

Dr. Blake's Sea Telephone.

At the annual meeting of the American Association for the Advancement of Science, in New York, Dr. L. E. Blake, the inventor of the Blake transmitter, read a paper on a method of telephonic communication between ships at sea. The plan was as follows: "A sound-producing apparatus was to be attached to each vessel, and to be worked under the surface of the water. In times of fog or at night, signals intelligible by means of a code would be produced by it, which would be transmitted in all directions through the water with a velocity four or five times that in the air. Each vessel, in addition to the sound-producing apparatus, would be provided with a sound-receiving apparatus, which would take up out of the water the signals arriving from neighboring vessels. 'All of us,' said Dr. Blake, 'remember when as boys in swimming how distinctly the sound of the striking of stones together under the water was heard. Just so distinctly is it possible to send musical tones from one ship to another.'"

"For steamships the sound-producing apparatus was designed to be a steam fog-horn or whistle, specially constructed to sound under water, and to be heard at least six or eight miles. From the nature of its tone it would be easily

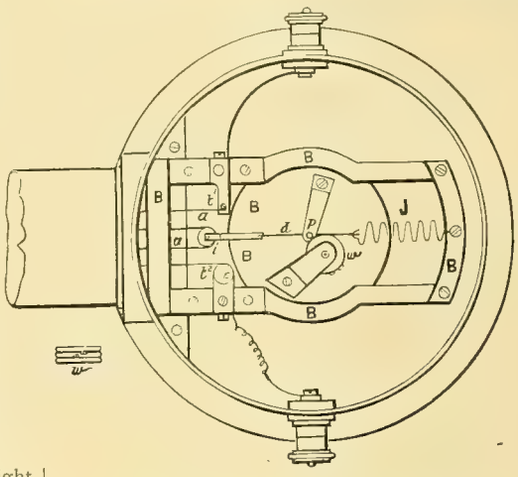


Fig. 2. Cardew Voltmeter.

distinguishable from other sounds always more or less present under water, from breakers and waves. With such whistles, a Morse alphabet of long and short blasts and pauses was to provide a means of extended communication, while a simple universal code would indicate a ship's course. Since ignorance of the very presence of a ship, rather than incorrect estimates of her course, has been the principal cause of ocean collisions, the simple hearing of the sound would prove a most excellent general safeguard. Bell buoys were to have a second bell added under water, while lightships, lighthouses, and any headlands might also be provided with submerged bells which could be rung from the shore when necessary; sailing craft, both large and small, would have bells, and since, an ordinary locomotive bell could be heard at least two miles under water, such simple means would seem to afford sufficient limits for protection for such vessels.

"'It is believed,' said Br. Blake, 'that sufficient has been done to show that the complete solution of this interesting and valuable practical scheme will lie probably in the telephonic method described. By this method in October, 1885, signals were transmitted and received one and one-half miles on the Wabash river from a locomotive bell, around three or four windings of the river, so that the operators were out of each other's sight. The sound could not be heard through the air, yet with fair distinctness could be heard through the telephone."

Death of John M. Gill.

John M. Gill, formerly representative of A. L. Ide & Son in Chicago, but since about the first of July representative of the Brush Electric Light company at Omaha, Neb., died very suddenly of heart disease at Aberdeen, Dak., on the 8th inst. He leaves a widow. Interment took place at Ithaca, N. Y., the 11th inst. Mr. Gill was widely known throughout the west, and his death will awaken pangs of regret in the hearts of many friends.

The monks of St. Bernard have brought the telephone into their service of mercy. The famous hospice is now in telephonic communication with the Cantine de Proz and the village of St. Pierre, as also with the Cantine de Fontinte and the village of St. Chemey on the Italian side.

Dangers to Human Life From Electricity.[1]

By F. B. Badt.

The dangers from electric currents known up to about twenty-five years ago, were those which pertained to discharges of atmospheric electricity (lightning), discharges of Leyden jars, and secondary currents of large Ruhmkorff induction coils. Since the middle of this century, the currents generated by powerful magneto—or dynamo-electric machines have caused their share of fatal accidents.

In order to understand the action of these different currents of electricity, we must first know of what kind of conductors the human body is built up. While to-day the total resistance of the human body is often assumed to be from ten thousand to twenty thousand ohms, scientists who have made this a subject of experiment, agree that it is greatly over-estimated.

W. H. Stone, in a paper read before the British association, published in *Nature*, mentions examples of the conflicting and contradictory statements made by different authorities as to the electrical resistance of the human body. He believes it to be enormously over-estimated; being given all the way from 13,000 to 2875 ohms and less. The task of measuring the resistance of the human body is met by three obstacles: First, difficulty of making a good contact through the skin of living man; second, limitation of amount of current by pain, and the tetanic condition of the muscles, which is the effect of rapidly opening and closing strong currents; and third, that the human body is an easy electrolyte, furnishing currents of polarization almost immediately.

Stone gives two ways of making contact: Immersing the hands or the feet in salt water in contact with an electrode of amalgamated lead or zinc: or by wrapping the limbs with thin sheet lead. Stone found as the result of his experiments that the average resistance from foot to foot would be about 936 ohms, and from foot to hand from 1,027 to 1,320 ohms, according to the height of the man. Other authorities think, however, that increase in stature is balanced by cross-section, thus making the average resistance about the same.

From this it will be very easily seen that currents even of very low e. m. f. will be unbearable to man, if proper contacts are provided. The fact that this latter will rarely be the case, explains how persons have withstood currents of hundreds of volts without injury.

The best conductor in the human body is the blood; next to this, the tissues. Therefore, if we read that a man in Texas was struck by lightning in the back of the neck, it can not be surprising that both his shoulder bones were found broken; the lightning, in its passage to the ground through his body, left the better conductors uninjured, but shattered the conductors of higher resistance which lay its route.

While we find this wide difference of opinion relative to the resistance of the human body, equally great discrepancies are found in estimates of the intensity of lightning discharges. All authorities agree that the e. m. f. of a flash of lightning is probably many million volts; they most decidedly disagree as to the intensity of current. While some authorities assume that the current of the most powerful flash of lightning is but a small fraction of an ampère, others believe it to be many thousand ampères; and one scientific gentleman even calculated it at fourteen million ampères. Some claim that lightning, though it be a current of electricity, does not obey the laws of Ohm, while others think it does. Whatever the truth may be, it probably lies between the two opinions, and flashes of lightning may be currents of only a fraction of an ampère, or upwards to hundreds of ampères.

For the benefit of those gentlemen who are not well versed in electrical units, I will add this: The ampère is the unit of strength or rate of flow of the current. One ampère is the rate of flow per second, caused by the e. m. f. of one volt, through the unit of resistance of one ohm. The quantity of electricity obtained by one ampère after one second is one coulomb—or one coulomb will give one ampère after one second. Just as we would speak of water running through a pipe at a rate of one gallon per second, meaning that one gallon of water will pass a given point in one second. The quantity of water obtained at this rate after one second will be one gallon, after two seconds, two gallons, after one-half second, one-half gallon. So that at a rate of one ampère per second, in ten seconds we would have accumulated ten coulombs; or if the rate were ten ampères per second, we would accumulate ten coulombs in one second.

Now, let us suppose the rate of the flow of lightning to be 10,000 ampères and the duration —as often estimated—$\frac{1}{20000}$th part of a second; the quantity of electricity in such a discharge would amount to only $\frac{10000}{20000} = \frac{1}{2}$ coulomb. I suppose this is what is meant by many authors when they speak of the very small "current" of electricity in lightning. The rate of flow, or the current strength, may be enormous, and still the quantity—depending upon the duration of the discharge—may be small.

The difference in mechanical effects between that produced by a quantity of electricity discharged slowly through a considerable lapse of time, and that resulting from discharging a minute quantity in the infinitesimal part of one second, may, perhaps, be fairly illustrated by rolling a heavy cannon ball slowly over the floor, and firing a tallow candle from a musket. The heavier missile will stop at an obstruction like a door, while the candle will pierce it like a bullet.

The majority of persons struck by lightning in the open air, appear to receive the shock in the head, after which it passes through the body and out at the feet. In some cases the arteries throughout the body have been broken and bled freely. In others, the skin has been burned and also the hair; deep furrows are sometimes dug in the muscles, and not a drop of blood shed. Usually there are no external signs of injury, or at most but faint marks, such as redness or swelling or blackening of the skin resulting from the discharge. Persons having afflictions of certain special senses have been entirely cured. Individuals have been deprived of memory; while others have been deprived of all movements and control of muscles, while their intellectual faculties remained in their normal conditions. Death does not always ensue immediately after the shock, despite appearances. Persons have lain in a passive state for hours, and in some cases several days, still alive, but showing no signs of life. Early putrefaction is a reasonable indication, as bodies decay soon after death from an electrical current. It is for this reason that autopsies, which, as a general rule, are made several hours after death, are of little value. It is very difficult to determine whether the changes found are produced by the electric current, or are simply post mortem changes due to decomposition. External indications, such as burns, discolorations and the like, are due to electrolysis, where the soft tissues have come in contact with the conductors; or are caused by the spark when making or breaking the circuit. The extent of such injuries, of course, depends entirely upon the e. m. f., and the length of time the current passes through those parts. Death may occur in three different ways: First, By sudden contraction of the muscles and stoppage of the heart's action (as in a surgical shock) and interference with the lung movements,—both caused by disturbances of the pneumogastric nerve; second, by a paralysis of the cerebro-spinal system; by paralyzing this nervous system, it loses its balancing power over the vasomotor nervous system, producing tetanic contraction of the heart and arterioles, causing instant death; third, by the electrolytic action of the current.

Monsieur A. d'Arsonval recently made some very interesting experiments as to the physiological effects of different sources of electricity. These experiments were published in number 16, April, 1887, of *La Lumiere Electrique*, and were made with the following apparatus:

1. A static Holtz machine, charging a battery of Leyden jars.
2. A galvanic battery of 420 volts.
3. Gramme continuous current machines.
4. Gramme alternating current machines.
5. Induction coils with and without condensers.

The results of the experiments of M. d'Arsonval are given in this resumè: Death by electricity may occur in two ways; First, by direct action (disruptive effects of the discharge, acting mechanically so as to change the tissues). Second, by reflex or indirect action (acting on the nerve centers which may be irritated in many ways). This simple distinction which is the result of a minute observation of facts, is of practical value in this: That in the first case, death is sure; while in the second, experiment has demonstrated that the individual can very often be restored to life by artificial respiration, if practiced immediately after the accident.

The dangers presented to us by the different sources of electricity may be summed up in a few words:

Firstly.—The static discharge is only fatal when received in the immediate vicinity of the base of the brain, or head of the vertebral column, and when the energy of the blow is at least equal to three kilogrammeters. Under these conditions, the different tissues (nerves, blood, muscles, etc.), struck by the localized discharge, will lose their physiological properties without any hope of cure. If the discharge has not energy enough to alter these nerve centers mechanically, it will produce the phenomena of stopping the respiration, stopping the heart's action, accumulating air inside the parenchyma of the lungs, of paralysis, etc.; —results which M. Brown-Sequard has obtained by irritating these regions with different excitants.

Secondly.—With a battery of 420 volts we can cause death only by frequent and long continued interruptions of the current. This death is due to the tetanic condition, indirectly caused by the current rather than by the direct action of electricity.

Thirdly.—The continuous current Gramme dynamo is only dangerous as claimed by M. d'Arsonval, on account of its extra-current when the circuit is broken. He has been able to verify the fact that compound wound dynamos are less dangerous in their discharges of the extra-current, than series wound dynamos. The extra-current of a series dynamo generating 20 ampères and 45 volts killed a guinea pig, while the extra-current of a compound dynamo generating 25 ampères and 110 volts had no bad effect. This difference explains itself when we consider that one part of the field is wound in derivation and shunts the greater part of the extra-current. I will state here that M. d'Arsonval has omitted the clean shunt wound dynamo which is extensively used in the United States, mostly for incandescent lighting, but by some companies also for arc lighting. One of the companies using a shunt dynamo for arc lighting has never had a fatal accident on its circuits, while the same can not be said for companies using series dynamos. The explanation heretofore given has been founded on the fact that the series dynamos used in these cases, generated a higher e. m. f. than the shunt dynamos. This explanation, however, is not satisfactory, as there are similar cases on record where 800 volts of series wound dynamos have proved fatal, while 1200 volts of shunt dynamos have proved harmless. The above explanation of M. d'Arsonval throws light on these facts: While the extra-current of a series dynamo will find but *one* route, i. e.: through the human body, the greater portion of the extra-current of the shunt dynamo will pass through the derived circuit of the field.

Fourthly.—An alternating current Gramme dynamo does not cause death unless there is present a mean difference of potential of over 120 volts.

Fifthly.—An extra-current, set up by an interrupted current passing around an electro-magnet, is more dangerous than that from an induction coil, especially if the latter should be connected with a condenser.

The danger of a discharge depends more on the duration than either on the e. m. f. or the intensity of current. The same is true for alternating currents from which the danger is proportioned to the number of reversals per unit of time.

Prof. DuBois-Reymond, the Berlin scientist, expresses this in the following law: "It is not the absolute density value of the current during each instant when the motor-nerve answers by contraction, but the change of this value from

[1] Read before the Chicago Electric Club, August 22, 1887.

one instant to another. The excitation to motion increases in proportion to the rapidity of uniform impulses, or to increased density in unit of time."

In concluding his paper M. d'Arsonval states that under the ordinary circumstances of commercial use, the current kills by reflex action. In most cases he has succeeded in restoring life to animals, shocked by electric currents, by practicing artificial respiration. Hence, if in any electrical establishment a man should receive a severe shock, artificial respiration should be resorted to at once; then the chances for restoring life will be great. The currents so far used in commercial industry in most cases kill by stopping the respiration. Artificial respiration by preventing asphyxia, will reinstate natural respiration. It may not be out of place here to mention a few methods of practicing artificial respiration:

1. M. Brown-Sequard says that for several years, one peculiar mode of excitation to re-establish respiration in cases as named above, has been used in the college of France. It consists in the application of the Faradic current on both sides of the larynx under superficial incisions of the skin.

2. Artificial respiration, as usually practiced, should consist in laying the person on his back, pulling his tongue forward and extending the arms over his head; then compress the chest slowly and regularly at the rate of about sixteen times a minute.

Physicians recommend that inasmuch as the current paralyzes the cerebro-spinal system, stimulants should be used, such as ammonia, alcohol, etc., for the purpose of arousing the cerebro-spinal system to action. And again: Use a one per cent. solution of nitro-glycerine in two drop doses, dropped on the tongue. This is immediately absorbed, and is one of the most powerful heart stimulants known to the medical profession.

Death from a heavy shock must be painless. It is estimated by psychologists that it takes the brain one-tenth of a second to collect itself and recognize the impression sent to it over the nerves, before any act of consciousness takes place. Noting the rapidity of an electrical discharge, there can be no consciousness of such a shock.

I will give a few extracts made from another paper of M. d'Arsonval which I thought very interesting. All physiologists agree that the energy of an electric excitation depends less on the intensity of the current than on the velocity of the fall of the potential (*Rapidité de chute de potential*) and the frequency of the excitations. This fact may be expressed in the following axioms:

Axiom 1. A battery and a dynamo, each delivering current in a straight circuit—both currents of the same e. m. f. and intensity—do not offer the same dangers.

If either circuit should be broken the battery circuit will give a hardly perceptible shock, while the shock from the dynamo may prove fatal. The danger comes alone from self-induction or the force of the extra-current. This force will depend upon the construction and size of the dynamo, whence we deduce

Axiom 2. Two dynamos delivering currents of the same e. m. f. and intensity into similar circuits may prove more or less dangerous, as their co-efficients of self-induction, and hence their extra-currents may differ greatly.

Axiom 3. The same current not dangerous in one circuit, may be so in another circuit,—i. e., it is sufficient to give the current a chance for self-induction by any means whatever to make it dangerous. M. d'Arsonval has verified these axioms by experiments. He operated with currents from two to twenty volts and from one to thirty ampères. Even with these comparatively feeble currents he succeeded in killing guinea pigs. We see, therefore, if we would avoid all dangers from the employment of electrical currents, there is absolutely no safety, save in letting electricity severely alone.

What shall we do to protect ourselves? Connect, for instance, between the binding posts of a dynamo, a series of accumulator battery plates in acidulated water in number sufficient so that their e. m. f. of polarization is higher than the maximum e. m. f. of the dynamo. This shunt cannot be passed by the direct current while the extra-current will traverse it easily and not injure the human body which may be in the circuit at the moment it is broken. The same protection can be obtained in many other ways, and it should be law to have each dynamo or battery—primary or secondary—of a higher e. m. f. than 150 volts, provided with a mouse trap apparatus, to catch the extra-current or strangle it at its birth.

In order to prepare this paper, I have examined a considerable number of cases of persons struck by lightning—in fact the medical journals are full of them. This is not surprising, as death from lightning is not by any means a rare occurrence. In France alone from 1835 to 1863, 6,714 persons were struck by lightning; 2,238 of this number were killed. These are very interesting statistical data, but unfortunately my confidence in them was a little shaken when intending to express the percentage of deaths of the total number of persons struck, for I found it to be just 33⅓ per cent.; 3x2,238 is exactly 6,714. I presume the writer found a statement of the number of persons struck, which assumed that about one-third of this number were killed; not satisfied with this, but desiring to be mathematically correct, he figured it down to exactly 2,238. What a blessing there was not a fraction!

I will not weary you by reading many of these very interesting cases, but conclude with the account of two accidents from arc light currents, as the most instructive to this assembly:

1st. Stunning and burn by an electric lamp by Prof. George Buchanan, professor of clinical surgery, Glasgow university, Feb. 13th, 1886. I quote: "Injuries from electric lamps are becoming not infrequent. In most of the cases related death has been instantaneous. In a case reported January 22d as occurring at Liverpool, the man was stunned and remained unconscious for a time, and on recovering was found to be quite blind. The case here related is very curious as to its causation and effect.

"William C———, aged 44, a workman in Clydebank building yard, was engaged at a crane on November 19th, 1885. At the extremity of the wooden area of the crane was an iron pulley, over which an endless chain hung, for raising weights. The man had occasion to pull at the chain, and while doing so, an electric lamp which was suspended above, by some mischance was lowered till it touched the iron pulley. The lamp was one of the arc kind. The instant this occurred, the man felt a shock pass through him, became 'doubled up' and then lost consciousness; but he did not fall to the ground, being held by the chain, which his hands firmly and involuntarily grasped. Some three or four minutes elapsed before the electric current was cut off at the machine, when the man dropped down on the ground stunned. He was taken to the Western infirmary about an hour afterward, by which time he had recovered consciousness, and could give a distinct account of what had happened. The injuries received were not very severe. There was a vesication on the palm of his hand where it held the chain, also one on the side of his neck, which rested against the chain during his pulling it down. On the side of his right foot in front, where the chief weight of his body rested in the act of pulling, was a spot about two inches square, where the tissues were completely charred by the heat of the current passing into the ground. There were no nails in the boots, and there was no perceptible evidence of heat on them, but the sole of his stocking was charred, opposite the charred part of the foot. Sir Wm. Thompson, who questioned the man after his recovery, explains that the moist foot of the stocking must have acted as the medium of conduction between the man's body and the ground, and so determined the seat of the burn.

"The symptoms complained of were not very severe; they consisted of a slight amount of general shock, a feeling of heat in the abdomen and chest, and dimness of vision; all of which passed off in twenty-four hours. The wounds were treated in the ordinary way. A large slough separated from the sole of the foot, followed by rapid granulation and cicatrization, and the man was dismissed cured in about six weeks.

"Sir Wm. Thompson suggests that if any of the bystanders had taken the man by the clothes and drawn his feet from contact with the ground, or had thrust a bit of dry clothing of any kind under his feet, the contact would have been broken, and the hand relieved from its grasp on the chain. The wonder is that an electric current powerful enough to char the thick integument of the sole of the foot, passing through the man, did not produce any internal mischief."

From the Boston *Medical and Surgical Journal*, Nov. 26th, 1885, "Dr. A. L. Hummell recounts some curious cases of recovery from electric shocks, which ought, according to all ideas upon the subject, to have proved fatal. Two of them are given in *Popular Science News*. One is that of an employee of an electric light company, who, while still grasping the wire in his left hand, cut it with a pair of pliers held in the right. The current was at once established through his body, and he was held to the wire at the top of a 30-foot pole, for three minutes at least, by which time a ladder had been procured and he was released by a fellow-workman. During this time, a current of 3,000 volts, or sufficient to run 50 arc lamps of 2,000 candle power each, had apparently passed through his body, yet he was able to reach the pavement with slight assistance, suffered little or no constitutional disturbance, save a slight rise in temperature, and was not confined to his bed. His punishment was limited to the charring of three fingers on his left, and and a small but deeply burned hole in the palm of the right hand. The only treatment was that applied for simple burns."

"Another case was afforded by one of the workmen of the Bell Telephone Co., who having climbed a pole belonging to an electric light company, in order to carry a wire over it, grasped the tie wire of the positive line with one hand, and that of the negative line with the other. Here he was held until an assistant ran five squares to the electric light station, when the circuit was broken and he was released. A rope had been attached to him and passed over the arm of the pole. This was held by another man and he was thus prevented from falling. Though unconscious for a while, he soon rallied; but his pulse never exceeded 86, nor his temperature 101°. The thumb of the left hand was burned nearly off, as were also the index and middle fingers of the right hand. These were all amputated."

NOTE.—I have omitted the name of the electric light company in the above cases for the reason that all these interesting accidents happened on the lines of one system, and I do not want it to appear that I had picked out this one company purposely.

A Century of Great Achievements.

Geo. L. Perkins, treasurer of the Norwich & Worcester railroad company, was born the 5th of August, 1778, and has consequently passed the ninety-ninth anniversary of his birthday. He entered railway service as a director of the company with which he is now connected at the age of thirty-five, and has held his present office nearly fifty years. What a marvelous revolution has been wrought by steam and electricity during his life-time. He was thirty-seven years old when the first railway in the world, the Stockton & Darlington was opened for passenger traffic; he was thirty-eight when the Erie canal was opened; he was forty when the first locomotive wheels began to revolve in the United States. When he had reached the mature age of forty-seven the total length of railway lines in the United States was only a little over 1,000 miles; when he was fifty-eight there were less than 5,000 miles; and he was eighty years old when our railway system aggregated 40,000 miles, or not much over one-quarter of the present total. When, in 1807, Fulton ventured the bold experiment of starting the first paddle wheel steamer on the Hudson, Mr. Perkins was nineteen; when the first steamer crossed the ocean he was twenty-nine. Not until he was forty-nine had Morse patented his telegraph, and he was fifty-six when the first telegraph line in the United States went into operation. Those of the younger generation of to-day recall the introduction of the telephone in their childhood, yet Mr. Perkins had long since passed his allotted three-score-and-ten when that event amazed the world. To very few has the privilege been granted of seeing such stupendous changes and improvements in a century of great achievements as Mr. Perkins.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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OUR San Francisco correspondent refers, this week, to the use of petroleum for fuel in California in place of coal. The southern part of that state seems to be thoroughly permeated with petroleum and prospectors have been looking for coal in conjunction with petroleum. Recently a large body of coal was discovered in the Santiago Canyon and the intelligence has proved very gratifying to the residents of Los Angeles county.

A FEW evenings ago a telegraphic feat was performed in Chicago which we do not believe has ever been equalled. A runaway team, attached to a coal wagon collided with a telegraph pole at the corner of Milwaukee avenue and North Leavitt street, the wagon striking with such force as to carry away the lower portion of the sound ten inch-cedar pole, breaking it off at the ground and again seven feet above, leaving the upper portion suspended with all the wires intact; not a wire broken nor a scratch made on the wagon. It takes a Chicago team to do that. Moral: Put the wires underground.

THE Business Men's association, of Buffalo, N. Y., recently adopted this resolution: "That we approve the proposition to introduce methods other than horse power upon our street railways. The widely extending boundaries of our city demand speedier methods of transit than horse railways can furnish, and we are glad to observe that it is now proposed, by adopting other methods, to supply this long felt want in Buffalo." The association, composed of the leading business men of the city, is a powerful one, and the virtual edict against horses as a motor for street railways is quite likely to be enforced. The same cry comes from other large cities, showing that the modern means of propulsion on street railways are demanding and receiving careful consideration.

ON another page will be found a description and illustration of the central lighting station recently installed at Vienna, reproduced from *Industries*. Many points of interest in the ground plan will suggest themselves to minds mechanically inclined, but which have not been referred to in the letter press. The double system of steam pipes providing against the contingency of stoppage on account of a break in them, or a bursted valve or accident of similar nature is an advantageous arrangement. It will be noted too that accumulators are to be used. We commend the illustration and article to the attention of engineers particularly, who will derive much interest and information from a study of both.

THE ably written article of Prof. Badt on "Dangers to Human Life from Electricity," read before the Chicago Electric club, last Monday evening, appears in this issue of our journal.

The subject is literally one of vital interest, and the increasing use of electric currents of sufficient strength for light and power renders it highly important that proper safe-guards should be provided for the protection of workmen and others whose daily duties bring them into close proximity with conductors conveying such currents, as well as of the public generally.

The importance of protection from lightning has not been over-estimated, as shown by the great number of casualties from this source which are referred to, but at the present rate of increase in the use of electricity the casualties from artificial lightning are soon likely to exceed those from natural lightning. The danger is perhaps no greater than from steam and gas, from railroads and elevators, and many other things which pertain to modern civilization. But while the danger cannot reasonably be used as an argument against the use of electricity, it should not be underestimated, ignored or concealed. It is better to acknowledge it and provide against it. Putting all electric light and power lines underground is one of the safety measures required; but the exposed portions at or near the junctions with lamps or machines are in most need of protection. The superior safety of shunt wound dynamos referred to in the article is an important point.

MR. EDISON'S proposed method for the direct conversion of heat into electricity, embodied in a paper read before the American Association for the Advancement of Science at its recent meeting, is given in another column, and will be read with interest. With the invention of the dynamo in 1867, rendering the conversion of mechanical energy into electric energy at economical rates possible, electricity passed from the seclusion of the laboratory to the wide field of practical utility more fully than ever before. But it is still largely dependent for its development on steam power; and it is evident that if the heat developed from coal can be economically converted into electricity without the expensive intervention of the steam engine, the results may be far greater than those which followed the invention of the dynamo.

Mr. Edison's method seems to be among the most practical yet proposed, since he employs metals not easily fused, as bismuth and antimony, which are used in the best laboratory instruments, and which, though capable of high electric development, are evidently not adapted to practical use on account of their low degree of fusibility.

It is to be hoped that the apparent success attending Mr. Edison's preliminary experiments may stimulate other inventors, and suggest to them more practical methods, and so hasten the grand final result.

Increasing Tractive Adhesion.

From the paper of Mr. Elias E. Ries, read before the American Association for the Advancement of Science, on "The electric current as a means of increasing the tractive adhesion of railway motors and other rolling contacts," the following excerpt is taken:

"In this system electro-magnetism provides the means whereby the increase in tractive adhesion is produced, and this result is attained in an entirely novel manner. Several attempts have heretofore been made to utilize magnetism for this purpose, but apparently without success, chiefly because of the crude and imperfect manner in which most of these attempts have been carried out. The present system owes its efficiency to the formation of a complete and constantly closed magnetic circuit, moving with the vehicle and completed through the two driving axles, wheels, and that portion of the track rails lying between the two pairs of wheels, in a manner similar to that employed in the electrical method before shown. We have here a model of a second motor-car equipped with the apparatus, mounted on a section of track and provided with means for measuring the amount of tractive force exerted both with and without the passage of the current.

"You will notice that each axle of the motor car is wound with a helix of insulated wire, the helices in the present instance being divided to permit the attachment to the axles of the motor connections. The helices on both axles are so connected that when energized they induce magnetic lines of force that flow in the same direction through the magnetic circuit. There are, therefore, four points at which the circuit is maintained closed by the rolling wheels, and as the resistance to the flow of the lines of force is greatest at these points, the magnetic saturation there is more intense and produces the most effective results just where it is most required. Now when the battery circuit is closed through the helices, it will be observed that the torque or pull exerted by the motor-car is fully twice that exerted by the motor with the traction circuit open, and by increasing the battery current until the saturation point of the iron is reached the tractive force is increased nearly 200 per cent. as shown by the dynamometer. A large portion of this resistance to the slipping or skidding of the driving wheels is undoubtedly due to direct magnetic attraction between the wheels and track, this attraction depending upon the degree of magnetic saturation and the relative mass of metal involved, but by far the greatest proportion of the increased friction is purely the result of the change in position of the iron molecules due to the well-known action of magnetism, which causes a direct and close interlocking action, so to speak, between the molecules of the two surfaces in contact. This may be illustrated by drawing a very thin knife-blade over the poles of an ordinary electro-magnet, first with the current on and then off."

Chicago Electric Club.

At the meeting of the Chicago Electric Club held August 22d, Gen. A. K. Stiles presided.

Treasurer F. S. Terry submitted a report showing a balance on hand. The report was ordered filed.

Mr. C. A. Brown moved the adoption of the amendment to Section 2 of Article III. of the constitution, making it read: "Non-resident members shall pay annual dues of $12. The amendment was adopted.

Mr. C. C. Haskins, on behalf of the *Electrical Review* presented the club a framed copy of the "mathematical properties of the wire gauge," which formed a part of the report of the wire gauge committee of the National Electric Light association in convention at Boston two weeks ago. On motion the gift was ordered hung in the club room and a vote of thanks tendered the *Electrical Review*.

On motion of Mr. John Young, the treasurer was directed to notify delinquent members to remit for their initiation fee and quarterly dues.

Mr. C. A. Brown moved that the present entertainment committee be increased by the addition of two members.

Mr. H. Ward Leonard offered an amendment that the committee be relieved and a new committee of five be appointed.

The club decided that the services of the committee were too valuable to lose, rejected the amendment and passed the original motion. Messrs. Haskins and Shain were appointed on the committee which now stands: Messrs. H. Ward Leonard, A. H. Brown, J. L. Barclay, C. C. Haskins and Charles D. Shain.

Mr. F. B. Badt then presented his paper, reproduced in this number of the WESTERN ELECTRICIAN, on "The dangers to human life from electricity."

On motion of Mr. Charles A. Brown a unanimous vote of thanks was tendered to Mr. Badt.

In the discussion awakened by the paper Messrs. Stiles, Badt, Leonard, Haskins, Sperry, and Bliss participated.

At the suggestion of Gen. Stiles a motion was presented and carried, to the effect that members of the club who desire to hear a specific subject relating to electricity discussed, bring it to the attention of the entertainment committee, and indicate to that committee the particular line of thought they wish followed.

On motion of Mr. Terry the regular meetings of the club were fixed for the first and third Monday evenings of each month, commencing with September.

The next meeting of the club will be held September 5th.

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number VII.

The Edison Dynamo.—Among the constant current dynamos the Edison is specially noted for its peculiar construction, though in the later styles its distinctive features have been considerably modified. The following brief description embraces the leading features of the machine as now constructed in the United States. Its field magnets consist of vertical cylinders, with large wrought-iron cores, resting on massive cast-iron pole pieces which nearly inclose the armature. The extreme length of core found in the older styles having been reduced, and the diameter correspondingly increased so as to preserve the massiveness, a feature which, in both cores and pole pieces, it is claimed, increases the magnetic intensity of the field and lessens the liability to magnetic saturation of the iron.

The armature is drum-shaped and in its general appearance very much resembles that of the Weston dynamo shown at *C* in Fig. 16. Its core consists of a number of sheet iron disks, insulated from each other by tissue paper, and mounted on an iron shaft, but insulated from it by an interior cylinder of lignum vitæ, while an external covering of paper insulates it from the coils. These consist of cotton-covered copper wire, stretched longtitudinally, and grouped together in parallel, twelve wires, more or less, in a group; all the groups being so connected as to form a continuous closed circuit. These groups are arranged in concentric layers, and are of the same number as the segments of the commutator, the ends of the wires in each group being attached to arms connecting with the commutator segments as shown in the Weston, Fig. 19; a spiral

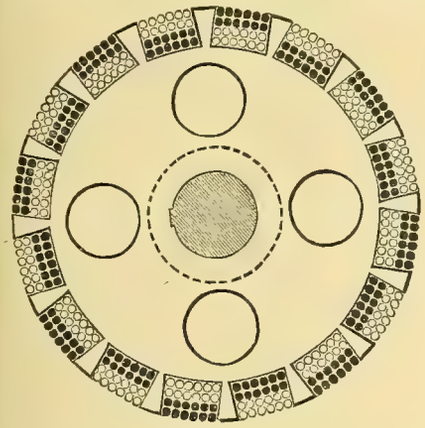

Fig. 17.

arrangement being adopted in making the connections between the straight portions of the wire and the arms. The object of grouping is to secure flexibility for winding by the use of small wire, and low electric resistance by having several wires in parallel, the effect as to resistance being practically the same as if the several wires were combined in one. At the ends the wires are insulated from the core by disks of vulcanized fibre with projecting teeth similar to that shown at *B* in Fig. 16. The disks of the core are bolted together by insulated rods, and the coils are confined by brass bands surrounding the armature.

The bar armature, formerly used in the large Edison dynamos has been abandoned. Its coils consisted of copper bars instead of wires, insulated by air spaces, and attached at the ends to copper disks, similar to the iron disks of the core, and mounted and insulated in a similar manner, there being as many disks as bars, two bars attached on opposite sides to two disks forming a coil.

The brushes are composed of several layers of copper wires, combined with flat copper strips, two layers of wire being placed between each two strips, an arrangement which is claimed to give a very perfect connection, and to prevent sparking by furnishing numerous points of contact, the copper strips confining the wire, and making the brush more compact.

The Weston Dynamo.—This dynamo also belongs to the drum armature type. The armature is shown at *C* in Fig. 16, and its core at *A*. The core, like that of the Edison is composed of sheet iron disks mounted on a central shaft, one of the disks being shown at *B* in Fig. 16. But the armature instead of having a compact struct-

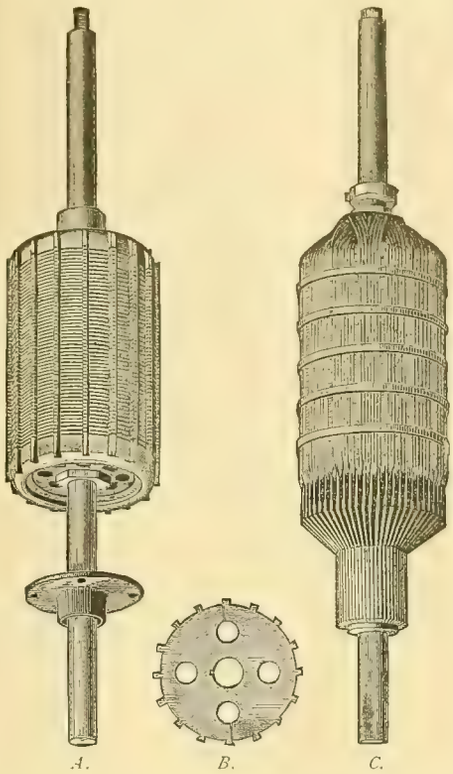

Fig. 16.

ure like that of the Edison, has an open structure. The disks are separated from each other at the center by small insulating washers, shown in Fig. 17 by a dotted line; each disk is perforated as shown, and has a number of cog-like projections on its circumference: these projections extend in straight lines along the core lengthwise, leaving depressions between them to receive the coils, and bringing the holes in the disks opposite to each other. The ends of the core are finished with thick disks, curved on the outside to prevent sharp bends in the wire. The coils lie in the depressions and are separated from each other by the projections, and a flange on the shaft at each end of the core separates the crossing wires, giving them an open structure around the shaft. Free circulation of air through every part of the armature is thus amply provided for, the open spaces between the core projections on the surface communicating with the

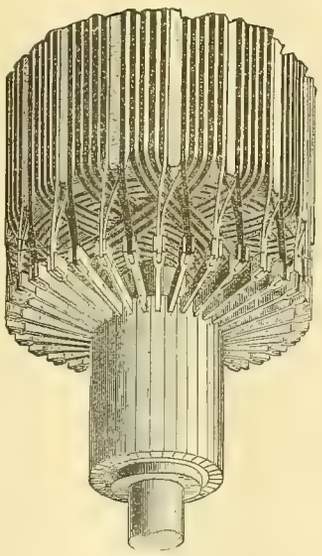

Fig. 19.

longitudinal tubular openings in the interior; so that when the armature is in rotation air currents are constantly flowing through it, between the disks and around the coils, rendering over-heating with its injurious effects an impossibility.

The advantages of the laminated structure of the armature core in both the Edison and Weston dynamos is obvious in preventing the formation of Foucault currents, and in placing the iron disks parallel to the lines of force in the magnetic field. The Weston has a further advantage in the projections extending beyond the surface of the coils into close proximity with the pole pieces of the field magnets, thus reducing the magnetic resistance to its minimum. In the attachment to the shaft advantages are claimed for both machines, the Edison for the insulation of the core from the shaft, and the Weston for its direct connection which permits the lines of force to pass through the shaft, while in the Edison they must circulate round it.

This armature is not compound wound like the Edison, the coils being composed of single large No. 6 wire, instead of numerous small wires grouped in parallel. The methods of winding vary in different Weston machines, but the prevailing style is shown in Figs. 17, 18, and 19; Fig. 17 representing the coils in cross section, Fig. 18 showing the connections with the radial arms of the commutator, while Fig. 19 shows the coils, commutator, and connections in perspective. The method of winding gives two circuits which are distinguished from each other in the cuts by dark and light shades. Beginning at *a* in Fig. 18 and tracing the dark line, it will be found continuous round to *b*; and tracing the dotted line in the opposite direction, it will also be found continuous from *a* to *b*, the two lines being joined together at those points. Each of the short loops near the centre represents a connection with a radial arm of the commutator, and Fig. 19 shows that these connections with the two circuits are made with alternate arms respectively while Fig. 17 shows the alternate positions of the coils as they lie in the depressions between the projections of the core. The arrows and

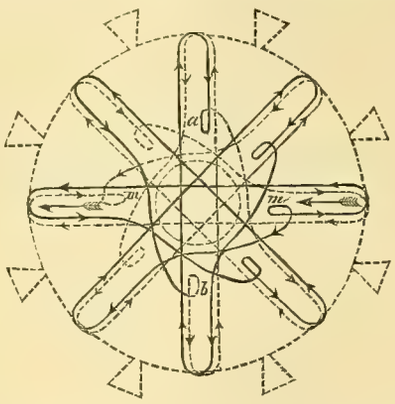

Fig. 18.

arrow heads in Fig. 18 show that the electric currents flow in opposite directions in the separate circuits represented by the full and dotted lines; and an inspection of Fig. 17 will show that this is a necessary result of the alternate positions of the coils as they pass through the magnetic field; each passing the points of greatest magnetic intensity alternately in advance of the other. But this does not interfere with the constancy of the current in one direction as it enters and leaves the main circuit at the commutator.

Effect of Electric Light on Libraries.

It was found that a large number of works in the library of the technical school at Vienna had become very yellow, and this led the director of the establishment to ask Prof. Wiesner to ascertain the cause of it. Experiment has shown that the coloration is due to light, but that it occurs only with paper containing ligneous substances, such as wood, straw and jute, and that it does not take place when through some chemical process the lignine that forms the essential part of the wood is removed. The yellowing is due to a phenomenon of oxidation. Solar light acts more energetically than dispersed daylight, which exerts but a very slight action when it is much diffused, and especially in a very dry room. Gaslight is nearly harmless, by reason of the few refrangible rays that it contains. On the contrary, as the arc electric light, and in general, all intense luminous sources, emit numerous refrangible rays, they favor the yellowing.

CORRESPONDENCE.

Eastern Electrical Comment.

NEW YORK, Aug. 20.—There have been so many underground railway schemes projected in this city that have not yet materialized that all of them are looked upon with suspicion. The utilization of electricity in tunneling, and also for the movement of traffic upon the completed line may, however, be considered as an important element in the future success of such plans. The East river tunnel is perhaps the most novel of these various enterprises, and the engineering plans are nearly completed. The company was incorporated in 1885, and preliminary surveys have developed no obstacles which are unusual in such an undertaking, the rock being of the same character as that which was so successfully tunneled by the government at Hell Gate for the purpose of blasting and improving the channel. It is necessary to obtain the consent of one-half of the property holders on the proposed line before the right of way can be secured, and canvassers have already entered upon this duty. If this plan is not successful the company will ask for the appointment of a commission under the law for tunneling under cities. The proposed eastern entrance is to be at Long Island city, and the western terminus at Tenth avenue and Thirtieth street in this city. Its depth below the surface of East river will be about one hundred feet, and the dimensions of the tunnel twenty-seven feet in width by twenty-one feet in height. The trains will be operated by electric motors, and the tunnel lighted by electricity. The new croton aqueduct is being built at a cost of $500,000 per mile, and upon this basis the cost of the East river tunnel is estimated at about double, or $5,000,000, for the entire length of five miles.

At least two fires and explosions have occurred this season in stores devoted to the sale of fireworks, which have led the authorities to take steps toward restricting their sale. Permits will be issued in accordance with the regulations of the fire commissioners, and all buildings where the sale of fireworks is allowed are required to be lighted either with gas or electricity.

The applications already filed for space at the electrical exhibition under the auspices of the New York Electrical society are in excess of the space allotted by the American institute. Seven hundred horse power has also been asked for to supply about 2,500 incandescent lamps, 200 arc-lamps and 300 motors. Three electric railways are on the list, but it may not be possible for more than one to be operated. It is, of course, to be understood that an immense variety of miscellaneous electrical apparatus will be exhibited. The electrical section of the exhibition will no doubt add materially to the popularity of the "Institute Fair," which has been one of the autumn attractions for rural visitors for the past forty years.

The development of the electric railway appears to be slower than it really is. The various enterprises are so scattered through the country that we do not fairly recognize the actual growth taken as a whole. The ten lines now in operation in America are located in nine different states, the tenth being in Canada. The eight now being constructed are in five different states. The forty-seven projected lines will be located in fifteen different states and territories. Quite a large proportion of these appear to have been proposed in order to occupy a special field for which neither the steam nor horse railroads are exactly adapted. Throughout this country there must be a vast number of favorable routes, which offer advantageous opportunities for the introduction of electric railways. Such a business once started grows without effort, and by its development of local territory continually adds to its future value. When it appears probable that in point of speed the electric motor is destined to surpass the steam locomotive, it may readily be imagined that an electric railway boom is among the possibilities of the next two years.

Those who are familiar with the early efforts of Stephen D. Field to successfully introduce the electric motor into the railway service, will be pleased to learn that he has now an opportunity of demonstrating the practical result of his study and experimenting during the past eight years. Although his labors have not been continually devoted to this subject, it has probably been uppermost in his mind, and the finished motor involving the important principle of direct connection between the armature and the driving wheels has now been placed upon the tracks of the Thirty-fourth street branch of the Third avenue elevated railroad. At this writing the trial trip in its new location has not been made, but as it operated satisfactorily at Yonkers, where it was built, it is to be hoped that there will be no failure in the more conspicuous position where it is now placed.

Work on the subways is progressing at a fair rate of speed on Broadway at Nineteenth street, and also at Cortlandt street. The complaints which were made regarding the gaseous odors from the disturbed streets have mostly disappeared from the newspapers. The trenches are not now kept open for more than a block at a time, and the health department has taken measures to disinfect the earth by sprinkling it with a solution of bromine taken from a tank in a wagon driven along the excavation. Many large boulders have been encountered in the vicinity of Twentieth street, some of which it was necessary to break in pieces before they could be readily removed. The Cortlandt street conduit leading from the new telephone building is composed of 104 ducts of iron pipe placed in eight layers of thirteen each. Among the curiosities brought to light is the old water system of yellow pine pump logs, which are found to be in a very fair state of preservation. There appears to be more unoccupied space below ground than was generally supposed, although some difficulty has been experienced in locating large man-holes at some of the street corners.

President Jacob Hess, of the board of electrical control, while indulging in an evening promenade discovered a gang of men hauling a cable into a conduit in the vicinity of the Union club. He asked to see their permit, which could not be produced, and he accordingly ordered the work stopped until proper authority could be shown for carrying it on.

Messrs. Bergmann & Co., who employ several hundred men at their electrical works, corner of Seventeenth street and Avenue B, have issued a circular to their employees, in which they say they have fully tested the experiment of paying ten hours' wages for nine hours' work, and that for the first time in the history of the business the past year shows no profit. Sharp competition and low prices compel them to return to the ten-hour system, which will be resumed on September 12th.

The board of aldermen of New Brunswick, N. J., have received a favorable report from the committee appointed to investigate the Van DePoele electric railway system with a view to granting permission for its use upon the line of the City railroad company. A resolution granting the company permission to erect poles in the streets, provided abutting property owners raised no objection, was referred to a special committee. The attempt to secure a franchise for the new electric railway at Elizabeth is meeting with sturdy opposition from the horse railroad people, who propose to introduce motors driven by storage batteries, and who argue accordingly that there is no reason why permission should be given for the erection of poles in the streets for an overhead conductor system.

Eugene B. Sanger, Mutual district telegraph messenger number 1,222, returned from England by the Germanic August 19th. His trip was made in thirty-two days, and had it not been for a misunderstanding about the hour of the steamer's arrival he would have been welcomed by a detail of fifty of his colleagues and escorted home from the pier with a brass band and a drum major. He was met by his aunt and Mr. Frohman, in whose interest the journey was made. All of his letters and souvenirs were promptly delivered, and the tickets were duly signed and returned. A pleasant little reception was given him at the Lyceum theatre by Messrs. Sothern, Frohman and other friends. It is presumed that this will be his last appearance as a district messenger, the value of his services having increased by reason of his foreign experience. P.

New York News.

NEW YORK, Aug. 13.—Last week a successful trial was made in Philadelphia with an electric car driven by a storage battery. Eighty-four cells of battery were used, these cells being stored out of sight under the ordinary seats of the car. The motor used was the Sprague, the whole apparatus being the combination of the Electric Accumulator company of this city. The car was first run around the test track in the shop-yard of the Wharton Switch company, rounding a curve of 33 feet radius and going up an incline of five feet in the hundred without any noticeable change of speed. The car was then run over the road, and the trip was a complete success, the car being under easy and absolute control all the time. Regarding the expense of running, the projectors claim that it will not cost more than two-thirds or three-fourths the cost of horses.

Cortlandt street has been torn up for a week by the Subway Construction company, and by the latter part of next week 104 pipes will be in readiness to receive the wires of the Baltimore & Ohio and the Western Union Telegraph companies and the Metropolitan Telephone company. The trench is ten feet deep at Broadway, and considerable difficulty has been experienced getting under the network of sewer, gas, water and steam pipes. The board of electrical control has ordered that after the work on Cortlandt street is finished, the subway be continued along Broadway to Park Row. It will connect there with the Chambers street extension of the East River bridge.

The Edison Electrical Illuminating company obtained in the Supreme court, Brooklyn, last Wednesday, an order upon the Electrical Subway commission to show cause why a mandamus should not be granted to compel it to grant the company permission to lay its wires under ground in several of the principal streets in Brooklyn. The object is to have the court construe the law, as the commissioners doubt their power to grant permission to dig up the streets.

The stockholders of the American Electric Light company have decided to dissolve the company. It has done no active business since 1882, when it united with the Eastern company to form the Consolidated company, which afterwards leased its rights to the Sawyer-Man company. The assets consist principally of consolidated stock, and these will meet all the obligations of the company.

Another experiment will soon be made on the Ninth avenue elevated railway with a Daft motor. During the last two years a number of trials have been made, but the motors used have not been of sufficient power. The one soon to be tried is 125 horse power, and the Daft people are confident that it will be sufficiently strong. The conductor is a copper rod, five-eighths of an inch in diameter, placed just outside of and parallel with the track. In addition to these trials, one is to be made in a few days on the Third avenue road with a motor invented by Stephen D. Field. Mr. Field has been at work some time perfecting his system, and thinks now that he has solved the problem, and that his motor will draw surface and elevated trains swiftly and safely. In his motor the armature is connected directly with the driving wheels, there being no gearing or belting used. The ordinary trucks of the car will be replaced by two motors, and these will be controlled by the conductor of the train from either end of the car. The current is transmitted to the motor by means of a third rail and a pick-up wheel.

The merchants of Philadelphia have been put to a great deal of inconvenience, and have suffered considerable damage on account of the condition of the streets that are torn up for laying underground conduits. As there is a limit to the time in which the streets may be torn up, the work is being pushed vigorously, and it is said that there is hardly a street in the city that is not almost impassable. The most extensive work is being done by the Penn Electric company and the American Telephone & Telegraph company.

The thirty-sixth annual meeting of the American Association for the Advancement of Science is in session at Columbia College. A large number of distinguished scientists are in attendance, and the meeting promises to be one of the most successful and interesting in the history of the society. At the meetings on Thursday and Fri-

day a number of interesting papers were read before the sections into which the society is divided. Among these were papers by Elias E Ries on the "Electric Current as a Means of Increasing the Tractive Adhesion of Railway Motors and other Rolling Contacts," and by E. L. Nichols and M. S. Franklin on the "Electro-motive Force of Magnetization."

The meeting of the Society for the Advancement of Science came to an end on Tuesday. The session has been well attended, 731 members having been registered present. Over two hundred papers were read, and in addition to the scientific work accomplished the social feature of the meetings has been made very pleasant. Thursday evening of last week a general reception was given to the members and their families at the Metropolitan Opera house. Friday afternoon a water party and reception was given by Mrs. J. S. T. Stranchan of Brooklyn, including a sail all around the upper bay. In the evening there was a reception given by the Torrey Botanical club. There were two excursions Saturday, one up the Hudson to West Point, and the other to Long Branch. Monday afternoon the Botanical section made a trip to Sandy Hook for the purpose of examining seaside flora. After the meetings there were excursions to Saratoga, Lake George, Lake Champlain and the Adirondacks. At the election of officers held on the last day, Prof. J. W. Powell of Washington, Director of the United States Geological survey, was chosen president, and Cleveland, O., selected as the next place of meeting. Among the resolutions passed by the society was the following: "*Resolved*, That in view of the rapid increase in the applications of electricity in ordinary affairs, its extensive use as a source of power, light, etc., in the near future, and the consequent importance of providing means for its accurate measurement, this association respectfully urges upon congress the importance of the establishment of a bureau of standards by which accurate standards of measure shall be constructed and established, not only for electricity, but for heat, light, etc., and arrangements made for the issue of authentic copies of the same whenever possible."

Papers were read the last day before the section devoted to physics by M. A. Veder on: "Is Terrestrial Magnetism concerned in Atmospheric Movements?" and by E. B. Elliott on: "The Mutual Action of the Elements of an Electric Current." An exhibition was given by Prof. E. E. Ries of a method of increasing the tractive power of steam and other railroad motors by the application of the electric current.

The United States Telegraph corps and the Old Time Telegraphers' association held their seventh annual convention in Philadelphia last Wednesday. There were fifty delegates present. Among them were D. H. Bates, president of the Baltimore & Ohio Telegraph company; J. E. Zeublin, general superintendent Baltimore & Ohio Telegraph company, Chicago; D. J. Ludwig, superintendent, New York; C. C. Hine, New York; J. H. Bunnell, New York; W. B. Wilson, Philadelphia; A. H. Bliss, Chicago; J. N. Crittenden, Chicago; William J. Dealey, manager Western Union Telegraph company, New York, and J. S. Cruise, Kansas City, Mo. At the election of officers David Brooks of Philadelphia was chosen president and W. J. Dealey of New York secretary and treasurer.

A large number of street railway companies in towns near New York have either decided to adopt electric motors or are seriously considering the question. The Brooklyn and Jamaica railroad is reorganizing its road and getting ready to use motors. The same company proposes also to furnish electric lights to the towns of Woodhaven and Jamaica. It is reported that the Brooklyn city railroad company is dissatisfied with the cable system as used on the Park avenue line, and favors a change to the electric system, using the Julien motors. An electric road is being built between Carbondale and Germyn, Pa., connecting the two towns. The Sprague motor will be used. Ansonia, Conn., expects to have an electric road in operation by the first of September, using the Van Depoele system. The directors of the Middletown, Conn., Horse railroad company have recently made a contract for the equipment of their line with the Daft system. Four cars will be put in operation at once, and a 60-horse power dynamo has been ordered for the central station. Overhead conductors will be used and the cars will be lighted by electricity. The Daft system is also being successfully used on a road in Orange, New Jersey, and on another at Asbury Park. About two miles of electric railway will soon be in operation in Woonsocket, R. I., power being furnished by the Woonsocket Electric Light company. Among other companies recently incorporated is the Coney Island Electrical Railway company.

The last of the sea-side meetings and dinners of the Electric club was held at the Hotel Brighton, Coney Island, last Thursday evening. The subject for the evening was "Storage Batteries," which was discussed by Dr. Louis Duncan of Johns Hopkins' university. The club has recently published its constitution and list of members in neat form. The latter shows a total of 182 resident members and 102 non-resident members. S.

Detroit's Budget.

DETROIT, Mich., Aug. 20.—The petition of the Brush company for an injunction restraining the board of public works from interfering with or obstructing the wires of the company was argued before Judge Jennison August 9th. For the purpose of the argument the practicability of underground work was not entered into, and counsel were instructed to confine themselves to the alleged violation of the city ordinance, the court remarking that if it had the power every telephone, telegraph and electric light wire would have to be buried. Counsel for the city then cited the ordinance, which states that when the common council deemed it necessary, it can order the wires put underground with six months' notice to the companies to comply. The reason the six months' clause was inserted was to give the companies ample time to comply with the ordinance without entailing any unnecessary loss. The city meant to be fair, continued counsel, but the fairness was not returned. The ordinance passed in 1884 states that they must be subject to all ordinances then existing or afterward passed. Instead of complying with the terms of a valuable franchise granted, the company had been violating every rule for the past three years, endangering the lives and property of citizens thereby. Counsel continued at some length, the burden of the argument being that underground work was practicable, because adopted in other places. Judge Marston replied on behalf of the company. He said the city had utterly failed to show any infraction of the ordinances. General charges were indulged in, but nothing specific was proved, or could be proved, and the court could take cognizance of nothing but actual proof. He went on to show that by the terms of the ordinance, granting its rights and privileges, practicability was a legislative, not a legal act; that this ordinance gave the company permission to erect poles, etc., under the supervision of the board of public works; it did not state it was necessary to obtain the permission of that board, nor did it imply that the board had a right to prevent the planting of poles, but simply that the board was to oversee the work. The court decided that a preliminary injunction must issue with costs, being of the opinion that the various resolutions referring to the placing of wires underground did not affect the Brush company's original ordinance to erect poles, etc. In the course of his decision, Judge Jennison said: It was conceded by counsel that the common council had power to adopt the Brush company's ordinance, and that its acceptance by the company constituted a contract. Hence, until repealed, or modified, the rights of the company under the contract remained unimpaired. There was another consideration worthy of notice. The Brush ordinance was adopted for the mutual benefit of the city and said company. Under that ordinance the latter had invested over half a million dollars, and for the purpose of better supplying the public with light, had purchased new grounds and expensive machinery, and at the time of the notice to remove its poles and wires, last July, was in the act of connecting the old wires with the new motors. The board of public works had knowledge of these facts, and even had it possessed the power, yet to permit such expenditures for the public benefit without protest, and then suddenly notify the company to place its wires underground January 1st, 1886, would be unjust and contrary to all equitable principles, without a notice commensurate with the work of removal and its consequences. The supreme court can definitely settle the question next September. If the company is found to be right in its action no one will be injured. If wrong, it must bear the consequences, however serious. The case will probably go to the supreme court.

The Thomson-Houston company has taken its wires out of the Dorsett conduits, and will hereafter use ærial lines.

The work of placing the city's wires underground is well under way, and it is expected that by the end of the month the system will be in operation.

The St. Clair & Sanilac Telephone company has completed its line as far as Ubly, Mich. The company has now ten offices. The agents at eight of them will soon be required to put in an appearance in court for using infringing instruments. The notice of these suits has appeared heretofore in these columns. Just as soon as possible after the establishment of an office the American Bell company files a bill of complaint against the user of the instrument. A few more offices remain to be established, if the original intention of the promoters is carried out, namely, to "extend the system and compete with the Bell company." The law's delay favors this plan; for offices can be opened faster than legal documents can be served, and as the extension does not involve any outlay on the part of the St. Clair company, much may be gained by it and nothing lost.

An item has been going the round of the state press stating that the Cushman Telephone company, of Detroit, would soon commence opening exchanges, and had alreay 200 miles of line up

The Michigan Bell Telephone company has put up another wire between Detroit and Port Huron, using number 12 copper. The Port Huron & Sandusky, Mich., line was considerably damaged by the recent forest fires.

West Bay city is looking around for a suitable electric light plant. It has $13,000 for the good work. C.

Indianapolis Items.

INDIANAPOLIS, Ind., Aug. 15.—The Indianapolis Brush Electric Lighting company have outgrown their present quarters, and are looking about for a larger building. The building they have in view is in the southern part of the city, and was formerly occupied by Emley Patent Railroad Frog Manufacturing company. It is their intention to do their own repairing, and also increase their plant, which at present is taxed to its utmost capacity to keep up with orders.

During a thunderstorm last week the telephone company had 50 telephones burned out by lightning.

Articles of incorporation have been filed by the Canadian Telephone Registear company. The object is the manufacture of a patent toll-collector for telephones, and the plant will be in this city. The directors are Charles Wittenberg, the inventor; Lee C. Averill, C. E Averill, Phillip Schloss, Bruce Carr, Ed. J. Robeson and W. C. David.

The lightning Thursday night struck the Jenney light tower in West Indianapolis, ran into the company's works in the Nordyke & Marmon building, broke a dynamo and put out the tower lights, "all in a flash," literally.

It has been rumored here that there is a prospect for an electrical railroad from Indianapolis to Crown Hill cemetery, three miles north of the city, thence to Broad Ripple, a summer resort, ten miles north. M.

Ottawa Chat

OTTAWA, Ill, Aug. 17.—The Central Union Telephone company are rebuilding their exchange at LaSalle, Ill. Number 12 steel wire is being used.

Spring Valley, Bureau county, Ill., has recently been connected by telephone with LaSalle, Ill., and the residents are happy.

The Central Union Telephone company have just completed a magneto fire alarm system, consisting of twenty stations, for this city.

The Cleveland Electric Manufacturing company have placed one of their time detectors in the factory of the Ottawa Window Glass works.

A new organ factory is being built of fireproof tile, manufactured by the Pioneer Fireproof Construction company, of Ottawa. The dimensions of the new factory are 380x80 feet, three stories high, with an L 120x80 feet, four stories high. The cost will be $80,000. Lane & Bodley, of Cincinnati, Ohio, will furnish the engine. It will be a one hundred horse power Corliss. U.

From the Pacific Slope.

San Francisco, August 17.—Articles of incorporation have been filed for the Nevada City Electric Light & Power company. Its purpose is to maintain electric lights and motors in Nevada City, Grass Valley and Smartsville, and mines and mills throughout Nevada county. Power is supplied by the Nevada County Water & Ditch Co. Capital stock is $15,000, divided into 1,500 shares at $10 each. The directors are the same as those of the Grass Valley Electric Light & Motor Co.

The Seattle American District Telegraph Co. has filed articles of incorporation. The capital stock is $3,000. Among the directors are F. T. Minor, Bailey Gatzert and H. G. Sturve. Erection of poles and lines was begun on the 7th.

A telegraph line has been established from San Diego to Ensenado, lower California.

The Grass Valley Electric Light & Motor company have filed articles of incorporation; capital stock $15,000, divided into 1,500 shares at $10 each. Directors are E. L. Campbell, Wm. Boericke, Chas. F. Burrell, H. H. Osborne and A. H. Clough. Dynamos are driven by water power.

A. H. Honey, superintendent of the Northern Pacific telegraph system, western division, moved his quarters from Portland, Ore., to Tacoma, W. T.

Articles of incorporation were filed on the 6th, of the Santa Ana and Long Beach Electric R. R. Co.

At Oliva Heights the electric light was successfully inaugurated on the 6th.

The Western Union telegraph office at Genoa has been ordered discontinued.

Articles of incorporation of the La Mesa & El Cajon railroad were filed on the 12th; capital stock $250,000. The road will be run from Fenalta, on the Pueblo line, connecting with the city electric road at that point to El Cajon valley, and will be completed at an early date. The survey has already been made and the ties ordered. This line will very probably be operated by electricity. It will be twelve miles long. The incorporators are W. E. Robison, S. J. Wrampeheimer, G. F. Judson, John Capson, T. J. Miller, G. L. London and A. W. Harley.

The contract has been let for the new hotel at San Bernardino for the wireing for 300 incandescent lights to Geo. R. Longdon. The contract for annunciator, fire alarm and return calls has also been let.

The Pacific Coast Electric Construction Co. at Oakland have abolished the use of a belt tightener on their main driving belt, and now use two 70 ft. belts, one 18 inches wide on top of a 20-inch belt.

Another company has been formed at Los Angeles to operate an electric railway by the Julien storage battery system. The road is to run from the Santa Fé depot along Santa Fé avenue, Georgia, Alameda, Fourth, Hill, Eighth, Hope and Eleventh streets to the western city limits. The company will ask the city council for a franchise.

Capital to the amount of $75,000, for the improvement of the Alvarado beet sugar mill at Alvarado, Cal., has been subscribed. An arc light plant for outdoor use and an incandescent plant for inside use will be purchased, as their other plants were destroyed by fire last year.

The third electric light company has started at Victoria, B. C.

A movement is on foot to establish in the near future a marine observatory and signal station at Cape Beale, or some prominent point on the Vancouver coast, connected by telegraph with Victoria, B.C. Possibly a life saving station will also be established.

Napa will start its incandescent plant about the 1st of September.

The electric light company and the electric railway company at Los Angeles use petroleum for fuel, which costs much less than coal.

About two years ago C. R. Lloyd, agent for the Jenney Electric Co., of Indianapolis, examined the Riverside ditch and expressed an opinion that the ditch would furnish a large amount of power and still be used for irrigation. Mr. Lloyd at once started to form a company to light the cities of San Bernardino, Riverside, Colton and a number of hotels and summer resorts situated along the line of current, and to furnish power for an electric street railway in Riverside, the paradise of southern California, and an electric road from Riverside to Colton and San Bernardino, a distance of fourteen miles. Mr. Lloyd was discouraged by many who had no faith in the idea of transmission of power and electric lighting from an irrigating ditch. Nevertheless he formed the company, and last summer a plant was established at San Bernardino which has run with the best of success at all seasons of the year, Poles are up from Colton to San Bernardino; 500 more are on the ground, together with 2,000 lbs. of wire and three long distance dynamos of special construction of Indianapolis Jenney company's make; 30,000 pounds of number four wire, two more Victor turbines and fifteen iron towers are on the road.

Work has been begun at Riverside, and as soon as the lighting station is completed the power generators will be put in and the electric road started. S.

Electrical Patents.

Issued August 9th and August 16th, 1887.

367,841. Electric Gas-Lighting System. George F. Perkins and John P. Hurley, Holyoke, Mass.

367,866. Coupling Dynamo-Electric Machines. Elihu Thomson, Lynn, Mass. Fusible plugs are placed in circuit between the armatures and the equalizing connection. The short circuit accidentally formed through equalizing connection, as when belt of one armature slips off, is interrupted by melting of plugs, thus saving armatures.

367,898. Magnetic Clock. Daniel Drawbaugh, Eberly's Mill, Pa. The propelling mechanism consists of a stationary electro-magnet across the poles of which a permanent magnet is carried by the pendulum in a well-known way. The novelty consists in the means for maintaining uniform distance between the electro-magnet and permanent magnet.

367,901. Arrester for Electric Currents. James P. Freeman, Chicago, Ill. An electro-magnet in a telephone circuit is energized, when the line is overcharged by lightning or otherwise. The armature of the electro-magnet is thus caused to switch the line to ground. The claims are limited to special details of construction.

367,925. Electrical Annunciator. William C. Poole and John Schnepf, New York, N. Y.

367,931. Electric Coupling. Charles Runels, Lowell, Mass. Two counterparts are each provided with conducting strips and spring plates. When counterparts are coupled, each conducting strip of each counterpart is brought into electrical connection with a corresponding spring plate of the other counterpart. The device is designed to unite the electrical conductors upon railway trains to signal between different cars.

367,934. Commutator for Electric Generators. Oliver B. Shallenberger, Rochester, Pa.

367,956. Binding-Clamp for Battery Electrodes. Horatio J. Brewer, New York, N. Y.

367,960. Electric Clock System. Charles L. Clarke, East Orange, N. J.

368,066. Railway Signal. Irving H. Brown, New York, N. Y. The invention consists in a circuit-closing device, which is operated by the engine automatically to sound an alarm thereon, when approaching an open drawbridge or misplaced switch.

368,088. Inclosing-Case for Electric Machines. Charles H. Hinds, New York, N. Y. The case is designed for frictional electrical machines, and is composed of glazed porcelain, which is sufficiently non-conductive to prevent discharge of the machine and at the same time remain free from all charge on its interior surface.

368,099. Primary Battery. Samuel W. Maquay, Tedworth Square, London, England. The positive element of the battery is formed from an alloy of tin, lead, zinc and mercury. The plates or rods are treated to alternate baths of dilute sulphuric acid and mercury, and heated, the process being repeated until each pound of metal has taken up a fourth ounce of mercury. The plates are thus amalgamated with the mercury. Sulphur used as a depolarizing agent takes up the hydrogen and prevents it from reaching the negative element and accumulating thereon. In the formation of the porous cell or partition, two parts of carbon are mixed with the usual clay, and the operation of baking performed in an air-tight muffle so that the carbon is not consumed. Various exciting liquids may be used, and special devices are provided to facilitate cleaning and inspection. An absorbing tray containing dry pumice stone or other absorbent is placed above the cells to take up the acid fumes and water. The invention is well covered by eight claims.

368,136. Cable Hanger. Frederick E. Degenhardt, Chicago, Ill. The invention consists in a slotted band connected with the hook at one end and provided with a tongue at the other. The band is clasped around the cable and secured by slipping the slot over the tongue and then bending the tongue upwardly.

368,149. Binding-Post. Patrick J. Higgins, New Vienna, Ohio.

368,190. Art of Converting Chemical Energy into Electrical Energy. Willard E. Case, Auburn, N. Y. The positive element of the battery is carbon, the negative element may be platinum. These elements are suspended in a jar containing sulphuric acid. On dropping crystals of chlorate of potash into the acid, current is formed in the conductor joining the elements. The claims, five in number, are upon the art.

368,191. Galvanic Cell. Willard E. Case, Auburn, N. Y. The carbon element and fine carbon are placed in a porous cup in the jar. The negative element is suspended in the jar, which contains sulphuric acid and chlorate of potash. The claims broadly cover the cell, thus constructed, and the process of oxidizing an element of carbon by adding chlorate of potash to sulphuric acid in such a cell.

368,195. Electrical Piano. George F. Dieckmann, New York, N. Y.

368,212. Electric Clock. Thomas B. Hornaday, Indianapolis, Ind.

368,217. Printing Telegraph. Jacob H. Linville, Philadelphia, Pa. The invention relates to a form of printing telegraph instrument adapted to print upon a page or roll of paper, ingenious electric mechanism being provided for shifting the paper at the will of the operator. This invention is illustrated with eight sheets of drawings and the specification, including the forty-eight claims, covers seventeen pages.

368,221. Circuit Changer. Charles W. McDaniel, Kansas City, Mo.

368,265. Electro-Mechanical Brake. Granville T. Woods, Cincinnati, Ohio.

368,284. Electric Wire Clamp Insulator. John R. Fletcher, Dayton, Ohio.

368,315. Means for Dissipating Electricity for Printing Machines. Louis E. Bathrick, Brooklyn, N. Y.

368,321. Battery Connection for Electric Conductors. Patrick Bowe, Jersey City, N. J.

368,336. Burglar-Alarm. Albert E. Hathaway, Needham, Mass.

368,342. Telegraph Key. David Kunhardt, Aachen, Prussia, Germany. The key is of the class having a multiple contact for the purpose of transmitting one and the same telegram simultaneously to several stations. The claim is narrowly limited to constructive details.

368,405. Electric Rock Drill. Harry N. Marvin, Syracuse, N. Y.

368,406. Electric Rock Drill. Harry N. Marvin, Syracuse, N. Y.

368,411. Synchronal Motor for electrical typewriters. James F. McLaughlin, Philadelphia.
368,450. Telegraphic Transmitter. Wieland H. Bloom, Galt, Ill.
368,512. Railway Signal. George D. Burton, New Ipswich, N. H., and Charles H. Magoon, St. Johnsbury, Vt. On pulling the cord in any car a circuit is closed from that car through a battery and bell upon the locomotive.
368,541. Printing Telegraph. Henry Mahnken, Brooklyn, N. Y. An improved form of polarized relay is used in operating printing telegraph circuits, two or more polarized relays being controlled by a single pole changing transmitter.
368,546. Electric Belt. Alva Owen, St. Louis, Mo.

NEW ENTERPRISES.

The Globe Milling Co., at Watertown, Wis., will put in a dynamo to light their three mills.

At Mason City, Iowa, Henry Maroh will build a $2,000 residence and fit it with electric bells.

At Birmingham, Alabama, a new city hall is to be built at a cost of $40,000. Edward Sidel, of the same place, is the architect.

Swinlin & Brannock, of Kansas City, Mo., will erect a residence block of fifteen houses to cost $150,000.

At the same place a syndicate will put up a seven story arcade building to cost $250,000. It will be provided with electric bells, and the electric light. F. J. W. Hart, of Kansas City, is the architect.

The Presbyterian society of Kingman, Kan., is about to erect a college building which will cost $25,000.

At Fort Smith, Ark., Captain Sam McLeod will build a residence dwelling to cost $8,000. He will light it with the incandescent electric light.

At Normal, Ill., Professor DeGarmo will build a residence, cost $3,000, from plans by E Cantine, Bloomington, Ill. The house will be provided with electric bells.

A K. of P. temple is to be erected in Bloomington, Ill., from plans by George Miller, architect, of the same city. Electric bells will be put in, but whether other electrical apparatus will be used is not yet decided.

At Kansas City, Mo., S. Wilson will build a $25,000 residence of three stories. It will be provided with electrical appliances.

At the same place, F. G. Brincefield will build five two-story frame dwellings at an aggregate cost of $10,000. Electric bells will be needed.

W. C. McKay, of Kansas City, Mo., will erect two residences to cost $8,000 and $7,500. Electric bells will be put in.

The Union Stock Yards Co., of Sioux City, Ia., will build a pork and beef packing-house at a cost of $200,000. Work will be begun at once. Edward Hankinson is secretary and superintendent of the company.

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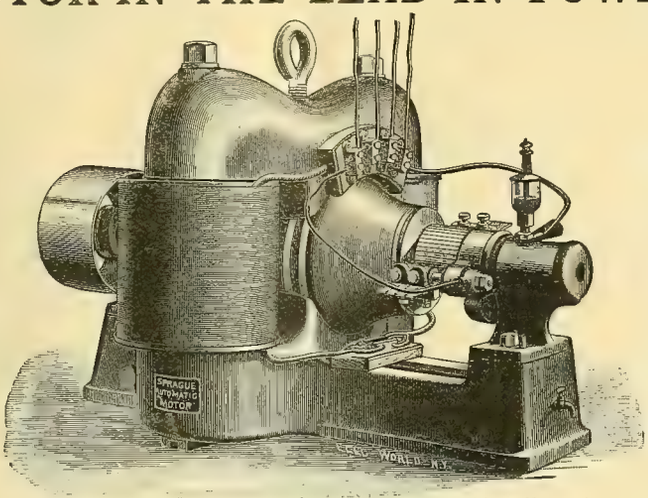

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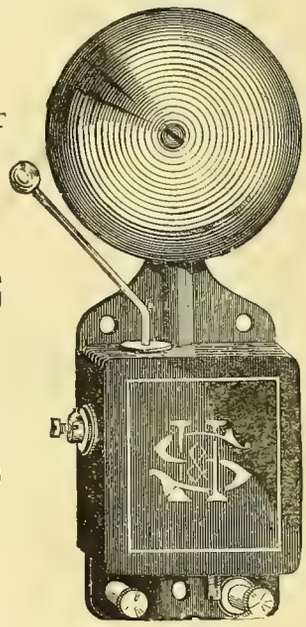

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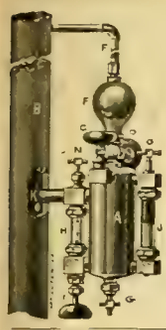

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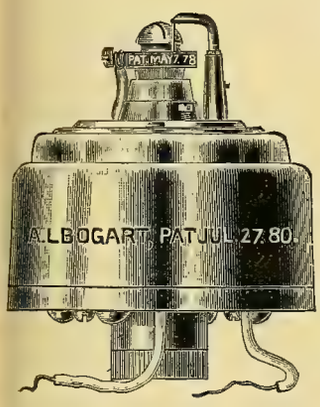

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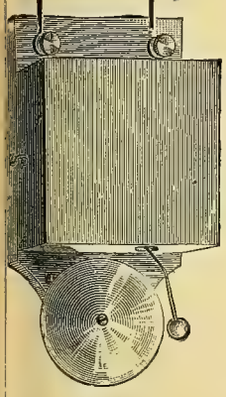

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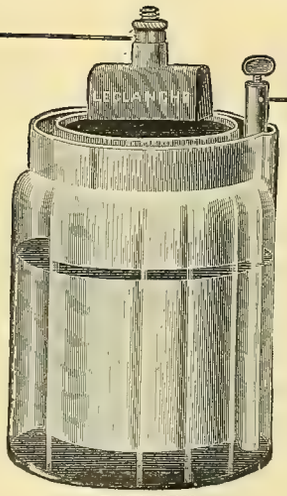

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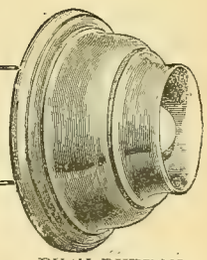

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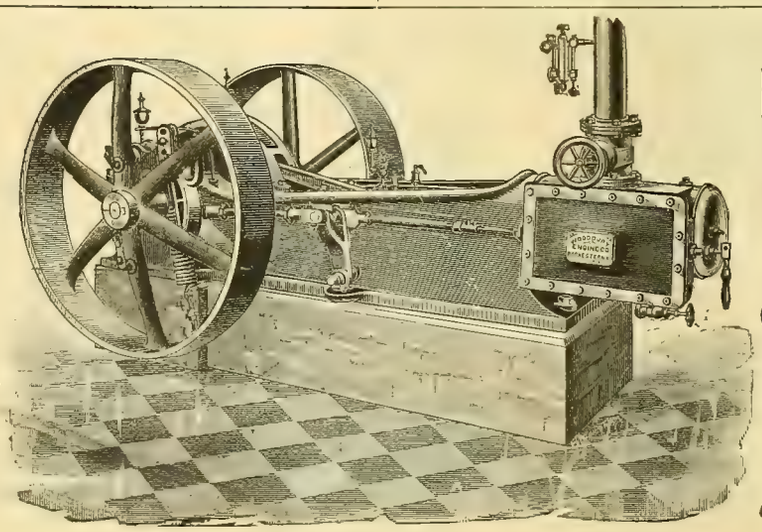

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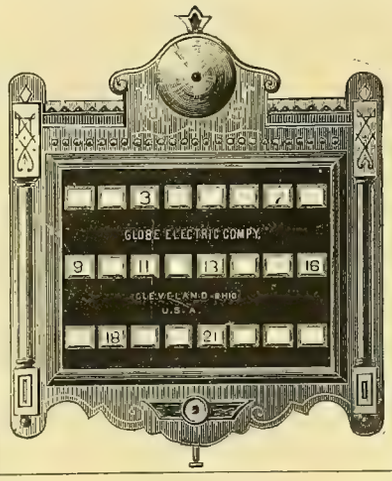

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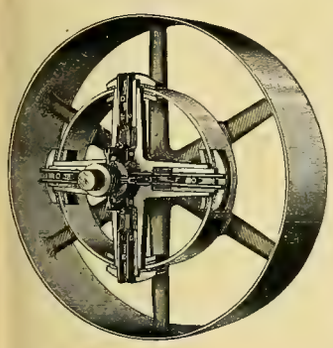

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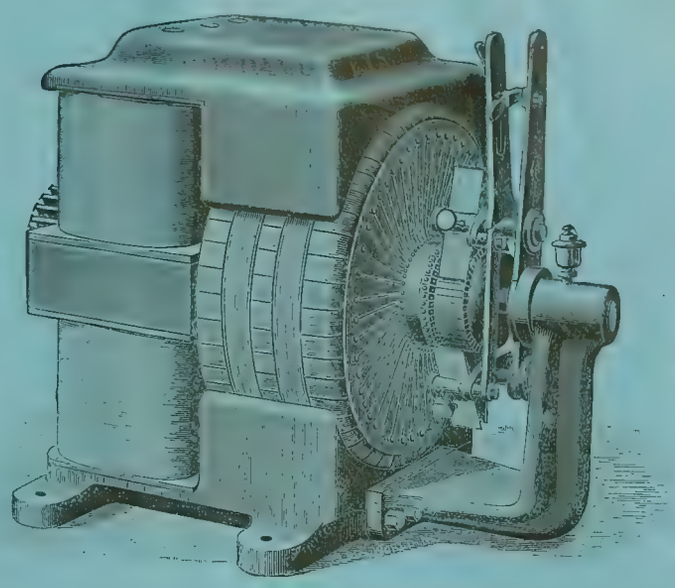

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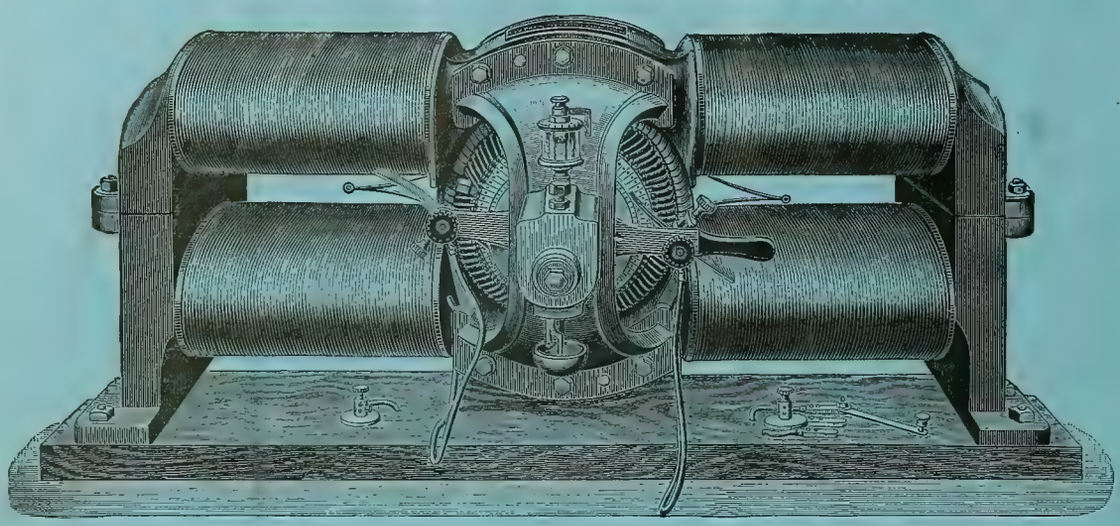

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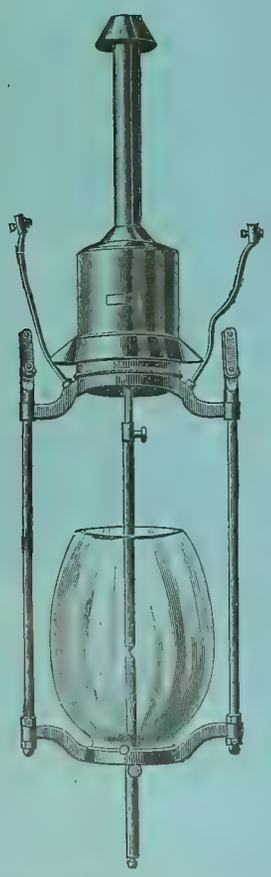

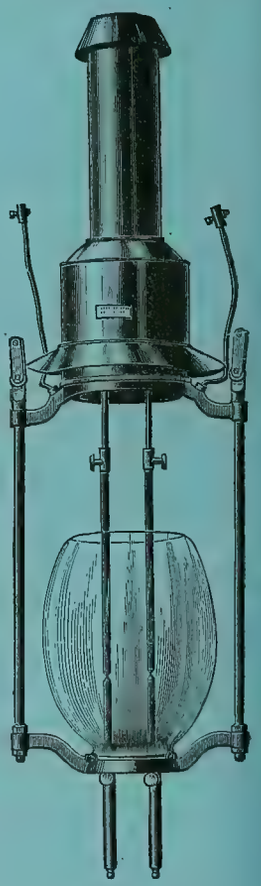

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Vol. I. CHICAGO, SEPTEMBER 3, 1887. No. 10.

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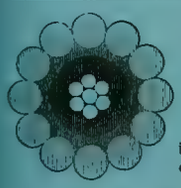

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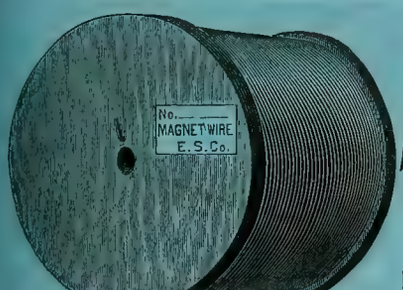

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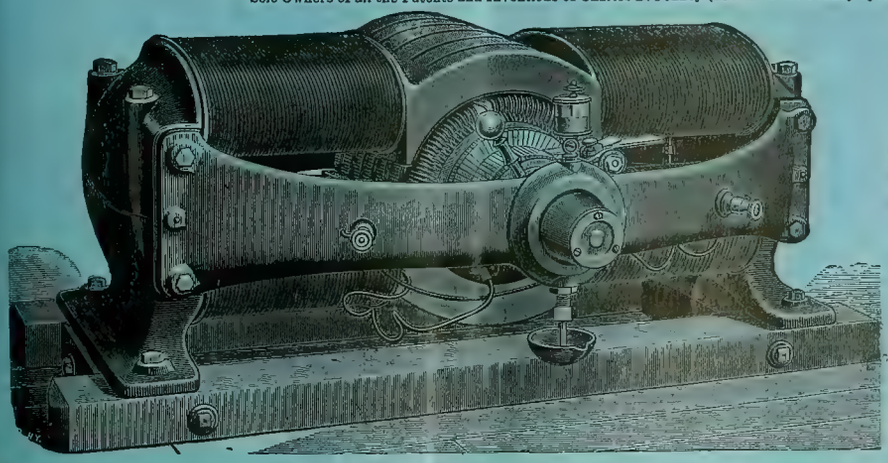

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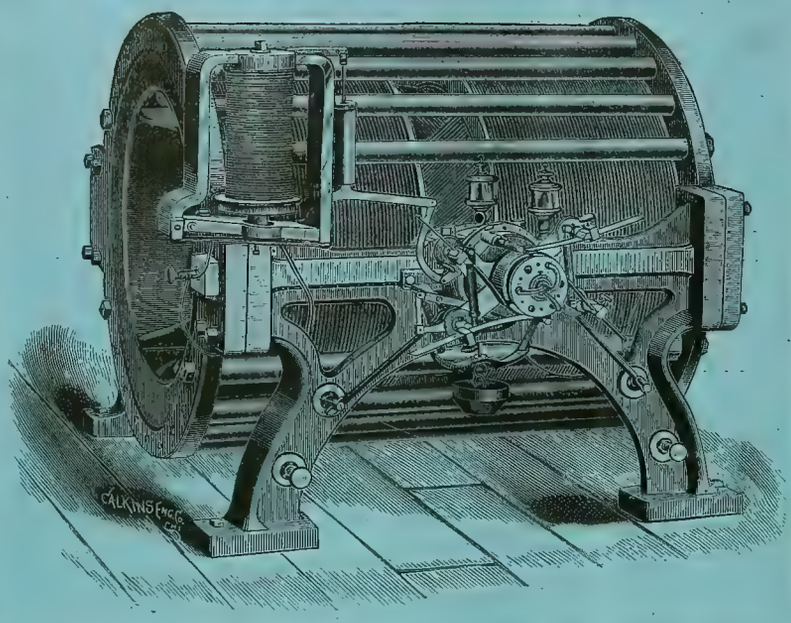

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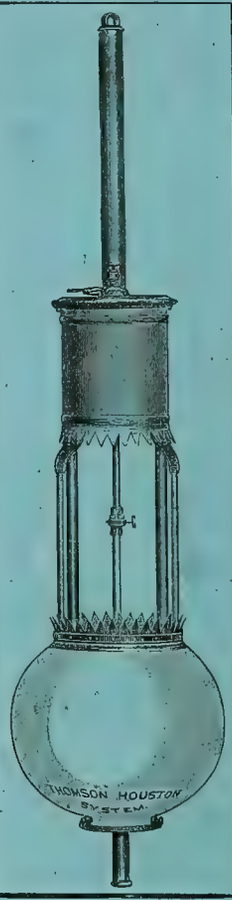

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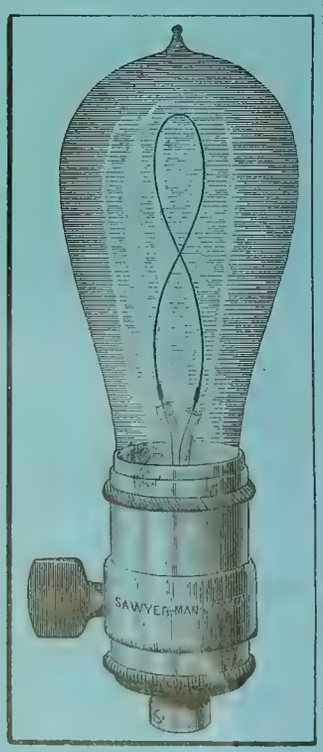

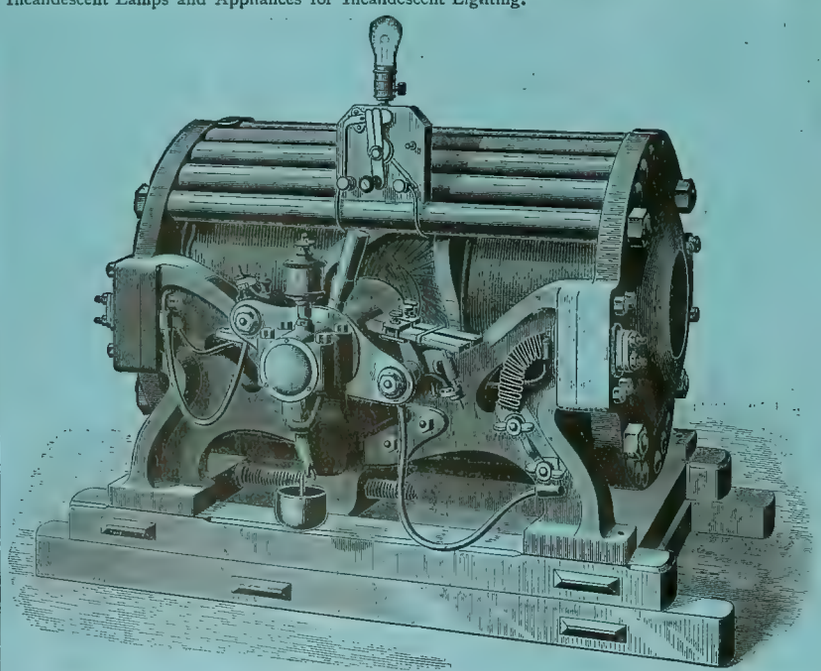

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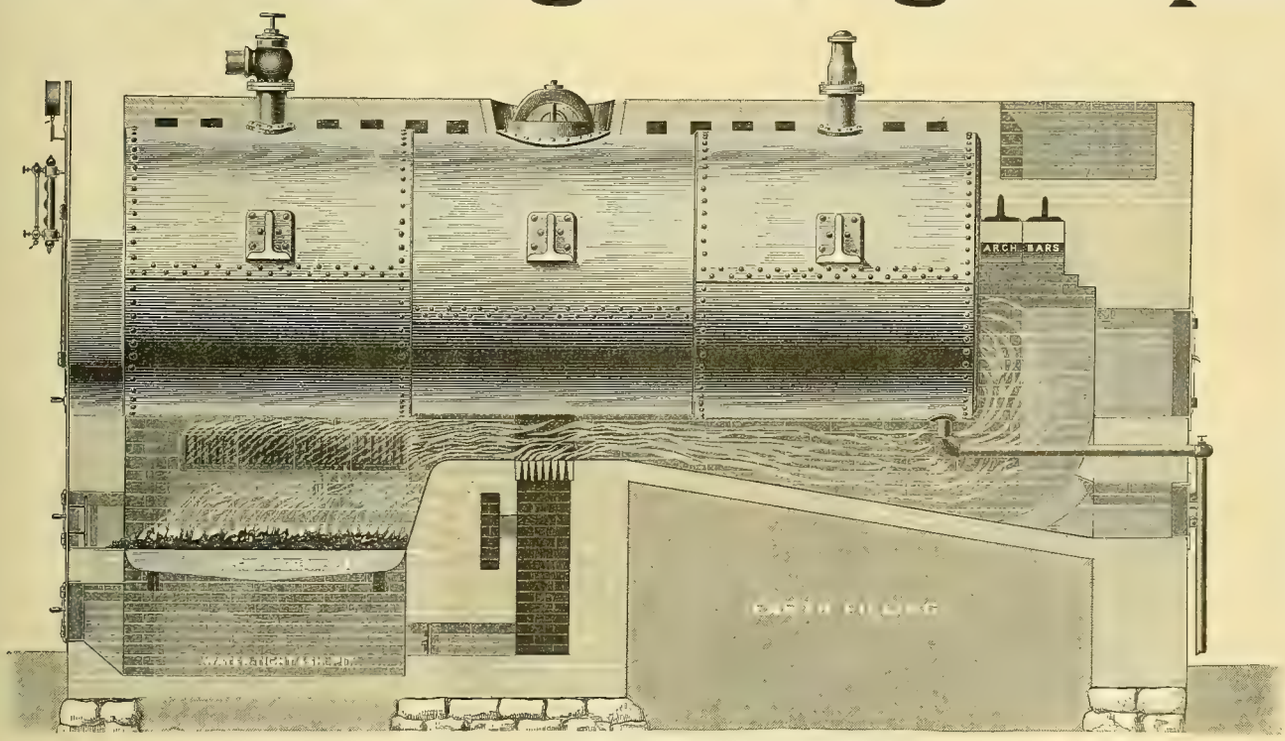

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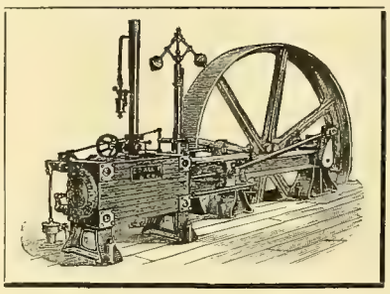

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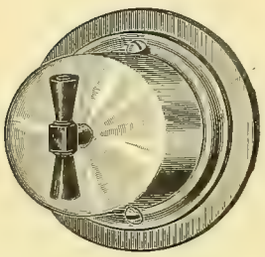

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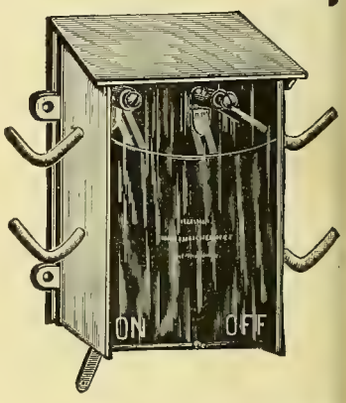
Quick Make and Break Uncontrolled by the Handle.

Correspondence Solicited with Electric Light Companies.



W. B. CLEVELAND, Proprietor,

26 S. WATER STREET, CLEVELAND, O.

FARADAY CARBON COMPANY, LIMITED

CAPACITY, 1,000,000 CARBONS MONTHLY.

QUALITY GUARANTEED EQUAL TO ANY IN THE MARKET.

LOW PRICE LIBERAL DISCOUNT ON LARGE ORDERS. CORRESPONDENCE SOLICITED.

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NEW ❋ YORK ❋ SAFETY ❋ STEAM ❋ POWER ❋ CO.

BUILDERS OF HIGH GRADE SELF-CONTAINED

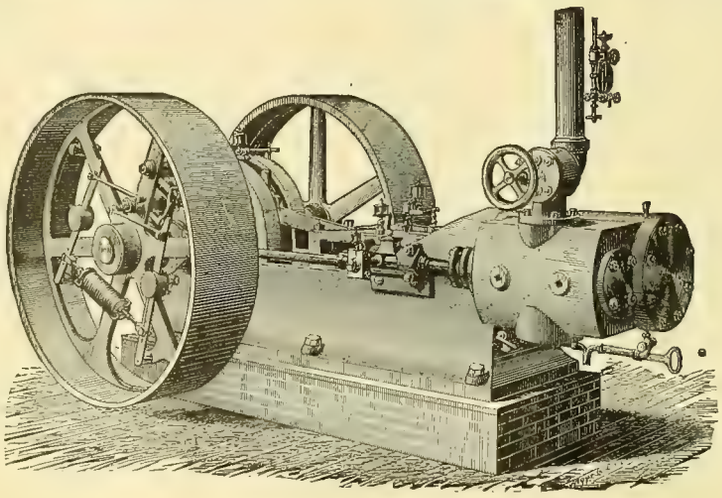
AUTOMATIC

Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC ❋ LIGHTS

And other duty requiring close regulation of speed.



ADVANTAGES:

Great strength without excessive weight
Small space required.
Simplicity of construction.
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ESTIMATES CHEERFULLY FURNISHED

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SELF CONTAINED AND SINGLE CRANK

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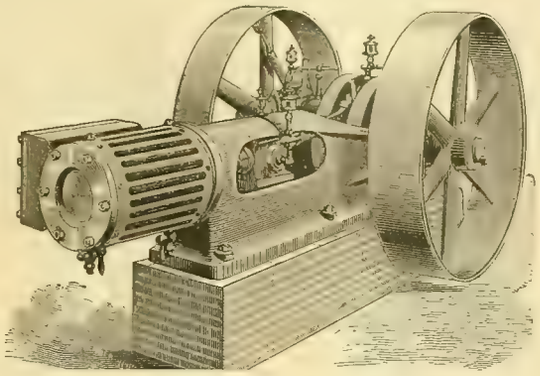


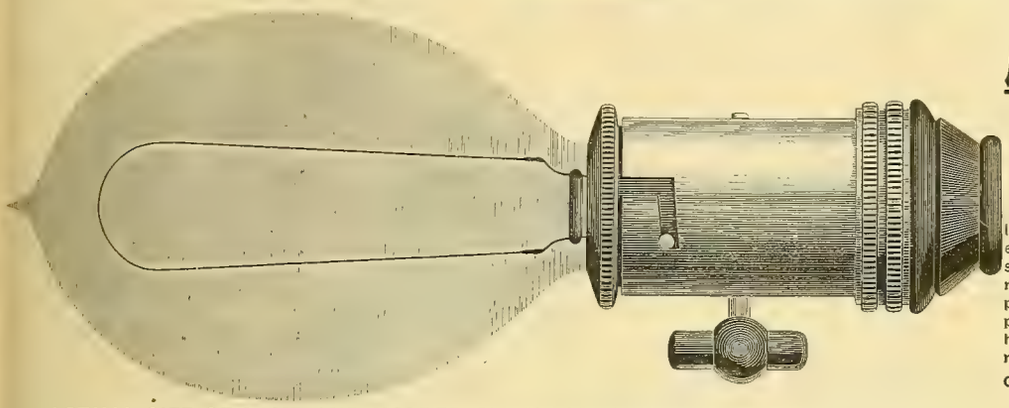
WESTERN DEPARTMENT:

No. 10 S. Canal St.

CHICAGO.

H. S. WALKER, MANAGER.

TELEPHONE 4024.



ACTUAL SIZE OF LAMP AND HOLDER (Size No. I,) FOR LAMPS 65 to 100 V. 16 C. P.

Aluminous Incandescent.

We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

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VITRITE & LUMINOID CO., 182 FULTON ST., NEW YORK.

Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode. Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the *works*, they require no shield or other protection.

Ask your jeweler for them. Send for Catalogue.

Geneva Non-Magnetic Watch Co., L'd.

177 and 179 Broadway, NEW YORK.

Central Electric Company,

M. T. GREENE, President.
GEO. A. McKINLOCK, Treas
WM. H. McKINLOCK, Secy.

38 and 40 La Salle Street, Chicago.

MAGNET
OFFICE
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ELECTRIC BELLS, BURGLAR ALARMS, HOTEL ANNUNCIATORS.

PRICES ON APPLICATION.

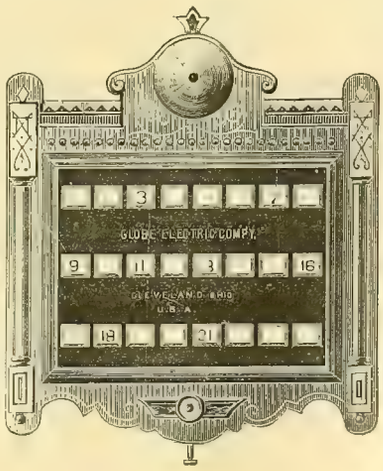
THE GLOBE ELECTRIC COMP'Y,

Wholesale Manufacturers of Every Description of Apparatus for

TELEPHONE COMPAN'ES,

SWITCH-BOARDS, SWITCHES,

Annunciators and Bell Supplies a Specialty.



The Globe House and Cole Drop Annunciators

Which are of the Best Material and Workmanship, are Perfect in Action, Simple in Construction, Elegant in Design, and Low in Cost. In addition they possess many other important advantages which are wanting in other Annunciators.

4 Indicators.	$12 00	40 Indicators.	$ 71 00
6 "	16 00	50 "	93 00
8 "	20 00	60 "	106 00
10 "	24 00	70 "	121 00
12 "	29 00	80 "	132 00
15 "	36 00	90 "	145 00
20 "	44 00	100 "	155 00
30 "	57 00		

With Alarm $3.00 Extra, Subject—

THE GLOBE ELECTRIC COMPANY,

CLEVELAND, OHIO, U. S. A.

Patterson Weather-Proof Electric Light Wire,

The best Fire and Weather-Proof Electric Light Wire in the Market.

The price is not greatly in excess of that for the ordinary UNDERWRITERS' ELECTRIC LIGHT WIRE.
Send for price list of this wire.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

DETROIT ELECTRICAL WORKS,

MANUFACTURERS OF

Electric Supplies

INCLUDING

Medical Batteries, Skeleton, Iron and Box Bells, Burglar Alarms, Hotel and House Annunciators, Fire Alarm Boxes, Pins and Brackets, Insulated, Magnet, Telephone and Electric Light Wire.

BUILDERS OF

Fisher's Electric Motors,

AND ALL APPLIANCES FOR CITY AND SUBURBAN

ELECTRIC RAILWAYS.

General Offices and Works, - - DETROIT, MICHIGAN.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE STILLMAN.
CLEVELAND, O.
THE ONLY FIRE PROOF HOTEL IN THE CITY
ELECTRIC INCANDESCENT LAMPS THROUGHOUT

Cleveland May 25th 1887

C. C. Warren, Mgr.
U.S. Electric Lighting Co., Chicago.

Dear Sir:— It always gives us pleasure to communicate ~~to communicate~~ the working of our electric light plant, which has been in operation since Oct. 1st 1885. For more than a year not a cubic foot of gas has been burned in The Stillman. We have the electric lights in every room, and can depend upon them absolutely. There has rarely been a stoppage, and never a serious interruption of the current, although the machinery is in continuous operation night and day.

The light undoubtedly costs less than gas; but were such not the case the avoidance of smoke and heat, and the saving of oxygen would make make it preferable.

Very truly yours,
The Stillman Co.
by H. P. Bell, Asst. Sec'y

ST. GEORGE HOTEL
THE PRIVATE OFFICE OF
D. J. Mackey & F. P. Huston.

Evansville, Ind. May 5 1887.

Mr. C. C. Warren, Mgr.
The United States Electric Lighting Co.
Dear Sir:

We started the Electric Light Plant you placed in our hotel April 2nd 1886 and have run the same continuously ever since we used no gas; our hotel being entirely and perfectly lighted by your system. We have had but little trouble and have always been able to adjust any thing that got out of order ourselves.

We believe your light the acme of perfection and after more than a year trial can say that we are perfectly satisfied and think the St. George Hotel is one of the lightest hotels in the West.

We are Very Respectfully
Mackey & Huston

The United States Electric Lighting Co.

Address: **C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.**

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, SEPTEMBER 3, 1887. No. 10.

Warner Testing Battery.

This is a new form of constant current battery made by the Western Electric company, and is specially designed for testing purposes It is compact and light, yet of substantial construction, and is particularly suited to the use of line inspectors on either electric light, telegraph or telephone circuits. The cells are of such form as to entirely prevent local action and with ordinary care and usage do not require frequent renewal. The battery principally used hitherto has been the chloride of silver cell. The Warner battery was designed to furnish something as efficient and reliable as the chloride of silver cell while being at the same time less expensive and less liable to difficulty on account of short circuit.

Chicago Arc Light Station.

After the Chicago Arc Light & Power company of Chicago had acquired by purchase nine independent electric light stations, it determined to consolidate as many of these stations as possible in one. The Central Manufacturing block, at the corner of Washington and Market streets, was secured, and the work of renovating and converting it into a modern electric light station is now nearly enough completed to enable the WESTERN ELECTRICIAN to give an idea of the equipment of the plant. The basement and the larger part of the third floor are devoted to steam plant and electric light plant and offices respectively.

The basement gives ample room for the steam plant. When that plant is entirely complete it will consist of thirteen boilers of Otis steel, four of which will be 66"x 18 ft., four 66"x 14 ft., and five 66"x 16 ft., the different lengths of the boilers having been determined by the space at command in the different divisions of the basement.

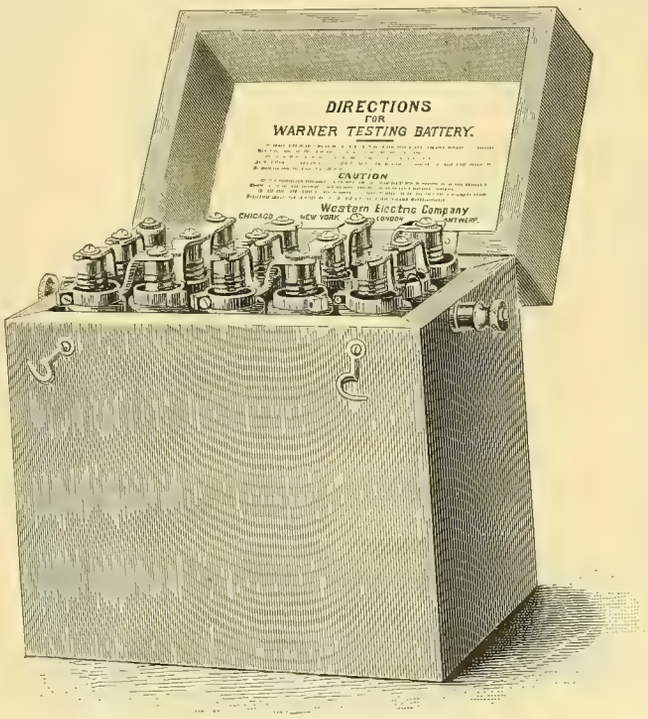
The storage capacity for coal is in keeping with the rest of the plant, being 25 ft. wide by 148 ft. long. In a room in the basement 35 ft. by 53 ft. will be placed the pumps. There will be one Corliss engine of 120 horse-power that will supply power to the other tenants of the building, and also an engine near it for running the elevator. The room for the electric light engines is 98 ft. by 29 ft., and will contain three Williams' compound condensing engines of 500 horse-power each, one Buckeye engine of 125 horse-power, and a small engine for running another elevator. An adjoining room will be devoted to one or two Buckeye engines when they are needed. The condensers will also be placed in the engine room. Masons are at present putting the finishing touches to a huge brick chimney, six feet and six inches internal diameter, and 126 feet high. This will give plenty of chimney capacity for the boilers now in and to be put in before winter. Another chimney of like dimensions will probably be erected next spring.

The dynamo room on the third floor is very pleasantly located. Light and ventilation are provided from the east side which overlooks the roof of the engine room, and from the west side which is next the river. It is free from dust from either side, and all in all will make a model dynamo room.

According to the plans devised to meet present wants there will be two main shafts in this room which will be belted to two of the three compound condensing engines in the basement. There will be one short shaft provided with clutches and connected with the third engine in the basement. This engine will be held in reserve, and by throwing the clutches into play, either of the main shafts can be engaged. This room will accomodate twenty-five 50-light Thomson-Houston dynamos. The pulleys on the main shaft will be the well-known Dodge wood split pulleys. The company believes itself the first to adopt in an electric light station a system of rope transmission. At present power is supplied to a single dynamo by this system, and the experiment so far has been very successful. About 1,200 feet of 5/8 inch manila rope, specially prepared, is run in six strands over pulleys from engine to shaft, making one right-angle turn. Provision has been made by a suitable device to keep the rope stretched, and there is no slackness of belt or belt slip to contend with. It is probable that four more systems of rope transmission will be put in place before the station is entirely completed. Other rooms, one to the south and the other east of the main dynamo room are at present devoted to storage of supplies and a repair shop respectively. The idea has been to fit the station for present and prospective requirements in the near future. If the business of the company warrants it, and there is every reason to believe that it will, the supply room will be converted into a dynamo room, and the whole floor will then be capable of accommodating fifty 50-light dynamos. If still more room is required for dynamos, the space devoted to the offices of Superintendent Cushing and his assistants, now at the north end of this floor, will be taken, and the offices removed to another place.

The plans for the electrical equipment of the station have not been completed, and it is possible to give only a general idea of this feature of the station. A switch-board will be provided on which it will be possible to plug in any circuit desired. The circuits will be carried out of the building in lead-covered cables. This department is in charge of Electrician A. H. Brown, who has just returned from an extended eastern trip, devoted in a large measure to investigating the best methods of construction of central stations.

The company is now burning from its various stations 1,100 arc lights. Its new station will be a model one, and there seems no doubt, from its steadily increasing business, that it will be forced to carry into effect the plans for enlargement so briefly outlined.



Electric Lighting from Car Wheels.

Geo. M. Pullman explains the method proposed to light Pullman cars by electricity, generated by the revolutions of the wheels, in the following manner: "We take the motor power from the car axle and have it run to a clutch device. A belt is driven by a pulley on the axle, and runs to this clutch device, the object of which is to run the dynamo in the same direction all the time when the cars require lighting. When the train is in motion we will get the light direct from the dynamo. At the same time a certain amount of electricity is passing into the storage battery. The secondary battery is to light the train when the wheels cease their revolution and the cars are standing in the depot. Each car will have a separate plant, so that a car can be disconnected and attached to any train desired. The dynamo will be set in a box and made fast under the car, swinging about sixteen inches above the track. A thirty-light incandescent machine can be used, thirty-six inches in length by twelve inches high. Any automatic dynamo can be utilized. Wires from the dynamo will be run up to the lamps through an automatic cut-off. When approaching a station, and the motor force decreases with the slackening of the train, the cut-off acts automatically to throw in circuit the current from the secondary battery. When the train starts again, and reaches its normal speed, the secondary current is shut off. When the secondary battery is sufficiently charged, a friction clutch on the axle may be used, by which the whole dynamo system may be rendered inoperative. When a car reaches the end of the route, and is obliged to stand still for several hours, a lever, which the porter can operate, throws the dynamo out of service."

A special dispatch from Boston of recent date, says that the Erie Telephone company has settled its differences with the Bell company with respect to the northwestern territory of the former. The arrangement is a perpetual contract for the northwestern division on the basis of a 30 per cent. interest in that section by the Bell company, upon which it waives all participation in dividends until Jan. 1, 1890. This is considered a very favorable contract for the Erie company. The net earnings of the Erie for the quarter ending June 30 were $48,512, or at the rate of $194,050 per year, the northwestern proportion of which is about $50,000, 30 per cent. of which is $15,000.

Synchronous Multiplex Telegraphy.

The report of the special committee of the Franklin institute, appointed to investigate the protest of Poul La Cour against an award of the Elliott Cresson medal to Patrick B. Delany for his synchronous multiplex telegraph system, has just been made public. Poul La Cour entered the protest that he had himself invented the system, and had taken out patents on it in other countries, but had disposed of his right to do so in the United States, and that his patents antedated those granted to Delany.

As may be inferred, the protest re-opened the matter, and the committee went over the whole ground again to see if additional facts could be found to change the opinion of the special committee appointed in 1884, upon whose report the award to Delany was made.

"The ground taken by the committee, appointed in 1884, was that La Cour was the inventor of the phonic wheel, upon which, as a basis, Delany founded his system of multiplex telegraphy. The institute accepted that view, and, at the suggestion of one of its members, awarded the Scott Legacy medal to La Cour for that invention. No credit was given La Cour for any device to produce synchronism between two phonic wheels, because the committee was perfectly well aware that not even approximate synchronism had been or could be produced by his apparatus; that after long and unwearied efforts by the most competent experts in America, his method, as described in his patent, was found to be impracticable; also, that La Cour himself, who came to this country, in 1881, to demonstrate the efficiency of his apparatus to the parties to whom he sold his rights in the phonic wheel, failed utterly to produce synchronism by his device.

"In the report of the committee of 1884, the fact was emphasized that the essential feature of Delany's system was its practically perfect synchronism, and that without this, multiplex telegraphy, by means of the phonic wheel, would be impossible; with it many other methods of telegraphy were possible, including autographic writing.

"La Cour saw that the phonic wheel could be made a valuable factor in a multiplex telegraphic system, if he could only produce synchronism between the two wheels. If the specifications in his patents, issued prior to the patents of Delany, do not describe a practicable way to do this, then he has no claim to be the inventor of a synchronous system. It is a general principle, well established in regard to patents, that the description shall be so plain that a person, skilled in the art pertaining thereto, will be able to accomplish the same results as are claimed for the apparatus by the inventor. Now, the proof is abundant that neither by La Cour's system, invented, as he says, in 1881, and which he claims is the same as Delany's, nor by his 'improved plan,' of October 7th, 1882, has any American electrician been able to produce a movement of the two wheels which approximates synchronism so nearly that multiplex telegraphy can be accomplished by it."

The claim was made by La Cour that two circuits over one wire were successfully worked in opposite directions by means of his synchronism, based upon his phonic wheel, between Fredericia and Nyborg, Denmark, a distance of forty miles, in June, 1880. The committee carefully investigated this claim, and came to the conclusion that there was no synchronism, or even approximate synchronism.

The subject of La Cour's later patents, antedating those of Delany, next receive consideration in the committee's report, and here again they found La Cour's claim of synchronism unsubstantiated. In fact, quoting from the report, "it is hardly necessary to say that this is not synchronism. The wheels are compelled to be out of synchronism all the time. It is not even close enough to be approximate synchronism, and it would be impossible to use such a system even for duplexing a line, to say nothing of creating a greater number of circuits."

In concluding their report, the committee state that in their opinion full justice was done La Cour in the award to him of the Scott Legacy medal and premium for the invention of the phonic wheel, but that to Delany belongs the credit of inventing and perfecting a highly successful synchronous system of multiplex telegraphy, based upon the phonic wheel, and that, therefore, they find no substantial reason for revoking the award of the Elliott Cresson medal to Delany.

Type Setting by Telegraph

At the American exhibition in London, the Thorne Machine company, of Hartford, Conn., show a very ingenious type setting and distributing machine. There are two cylinders, mounted vertically one above the other with the same axis. The upper one is the distributing cylinder, and the lower one the setting cylinder. The types before distribution are arranged in vertical channels in the upper cylinder, where they rest upon their sides. The distributing cylinder revolves with an intermittent motion, thereby causing its channels at each step to coincide with and rest directly over similar channels in the setting cylinder, which remains stationary. Ordinary fonts of type are used, but each character has distinctively arranged notches, with which correspond wards at the upper end of each channel in the setting cylinder, so that a type of a given character can only fall into its own proper groove in the latter; in these grooves the types rest on a bottom plate. The types in the distributing cylinder are in the order they come from the forms, but by the step-like motion of the cylinder and the action of the wards in the channels of the setting cylinder the types are automatically sorted, so that each channel of the stationary cylinder contains only types of the same kind. Composing is effected from a keyboard—like that of a type writer on a somewhat larger scale. By the depression of any key, through an arrangement of levers and rods, the lowest type in the corresponding groove of the composing cylinder is pushed radially outwards on to a very rapidly revolving disc, which carries it to an opening in the stationary guard surrounding the disk and delivers it upon a moving belt, on which the types are carried in their proper order to a revolving lifter, which raises them in succession into a long setting stick in front of the operator, terminating in a justifying stick at the upper end of an inclined channel or galley. In justifying, a section of the composed line of type is drawn to the mouth of the justifying stick, and is justified with spaces taken from a case containing channels for the different spaces and the hyphen, the lowest of which are pushed partially out by ejectors worked from a treadle. The lines are then made up into columns and pages in the usual manner. The lines of type when no longer required for printing can be inserted in the grooves of the distributing cylinder from a special galley by means of a slide with which a whole line at a time is pushed bodily into a groove. It is claimed that this machine will distribute and set at the rate of 12,000 ems per hour, doing with two men and a boy the work of six men working in the ordinary way. Considering the purpose for which the machine is intended, the construction is simple, and there appears to be no difficulty or hitch in the working. It should be remarked that by manipulating the keys in one direction only several may be touched simultaneously, without risk of the characters becoming transposed; in working the opposite way each key must be touched separately. The machine is driven from an overhead shaft by two small belts, very little power being required. One belt transmits motion to the revolving disk below the type setting cylinder and to the type lifter, while the other belt, by means of a tightening pulley and ratchet gear, produces the step by step motion of the distributing cylinder. The company intend to apply this machine at certain newspaper offices connected with the central office by telegraphic wires, so as to act as a receiver for press messages which are now recorded by private printing telegraphs. In this case all the key boards would be operated from a telegraphic instrument at the central station, and each of the newspaper offices at which the machine is established would receive automatically not only the messages, so to speak, but also the composition itself, ready for printing. The scheme is an ambitious one, and amounts to nothing less than type setting by telegraph, there being only one operator at the head office for any number of machines, which may be distributed throughout the country. Whether this comprehensive scheme will be practicable experience alone can prove. One of the objections is of course that the speed with which the type setter can work is very much less than that at which ordinary messages can be telegraphed, while the absence of editorial supervision in the arrangement and wording of news would be inconvenient.

Traveling Platform for Exhibitions.

At a recent meeting of the French Architectural society, M. Eugene Henard read a paper describing his proposed system of inter-communication for large exhibitions, with special reference to that of 1889 He proposes to lay down a railway line of standard gauge in a trench passing with easy curves through the principal avenues of the exhibition and returning upon itself, the whole forming an endless railway, on which will be run a close coupled train of trucks equal in length with the line. The trucks are to carry platforms a few inches above the level of the exhibition floor, the joint between platform and floor being protected by an angle iron and leather or india-rubber band. Power will be supplied to the endless train by electro motor carriages, one of these being estimated for every ten trucks. The current required for the motors will be supplied from various dynamos along the line, and will be controlled from a central station. The speed of the train is fixed at three miles an hour, in order that it may be possible to step on or off the traveling platform whilst the latter is in motion; but to provide for timid or infirm people, the inventor proposes to arrest the train every minute for fifteen seconds. In order to insure the safety of this traffic signalmen will be stationed in boxes along the line at distances of about 45 yards, and each signalman has the power of stopping the train or preventing its being started from the central station, should he deem this necessary. For this purpose there is an independent signal line passing through all the cabins in series, where there will be provided switches which can be opened by the signalman. Ordinarily these switches are closed, and a powerful battery current is kept continually circulating in this line. At the central station there is an electro-magnet energized by this continuous current, and the armature of the magnet when attracted is arranged to hold out of action a trigger gear. However, should the signal current be broken at any point by one of the signalmen opening the switch, the armature of the controlling magnet drops, releasing the trigger, which in its turn lets go a weight, and this breaks the main working current. The man in charge of the train at the central station is therefore only able to start the train or to keep it in motion if all the switchmen in the cabins keep their contacts closed. Speed indicators and regulating apparatus for maintaining the speed of three miles during each minute's run are fixed on each of the electric locomotives; but it seems doubtful whether it will be possible to stop and start a train of this enormous length and corresponding weight every minute without great loss of power and excessive strain on the electric machinery. Seats are to be provided on the traveling platform, for which a charge will be made.

The Australian Cable.

The British minister of railways, from London recently cabled to Ottawa in regard to the proposed Australian cable: "The Pacific cable question stands as follows: Sanford Fleming proposed that the imperial and colonial governments subsidize a new cable from Vancouver. The imperial government intimated that they could not by subsidy become parties to a concern which must compete with existing independent concerns. The Australian government thereupon declared that they could not subsidize the cable unless the imperial government co-operated. There is a suggestion now before the Australian and imperial governments for a joint government purchase of the Eastern telegraph and other systems and the joint construction of a Pacific cable, thus creating a system of government cables throughout the empire. It is calculated that an annual payment of £50,000, made up of contributions from each colony interested, including Sarada, would suffice."

Erection, Operation and Principles of Steam Engines.[1]

A piston valve is not necessary to the single valve system of automatic regulation. It has been adopted by most builders of that class of engine on account of its freedom of movement, (being perfectly balanced,) and on account of its simplicity of construction. The objection to the ordinary piston valve is its leakage.

The Ball engine, for one, does not use a piston valve, but a flat valve, nearly balanced, and with double openings both for steam and exhaust. Figure 1 is a horizontal section through cylinder and valve. It will be seen that the valve faces are horizontal, and the steam and exhaust ports arranged very much like the ordinary steam and exhaust ports of slide valve engines. There are two seats and sets of ports however, just equal and opposite each other, forming a part of the cylinder casting. Between these seats works the valve as shown in figure 3. A view of the valve itself is given in figure 2. It consists of two flat valves placed with their backs toward each other, and having on their backs circular sleeves nicely fitted to each other (one within the other) the inside sleeves being provided with packing rings to maintain a steam tight joint.

It will be seen that each half of the valve is allowed to adjust itself to its seat and the area of

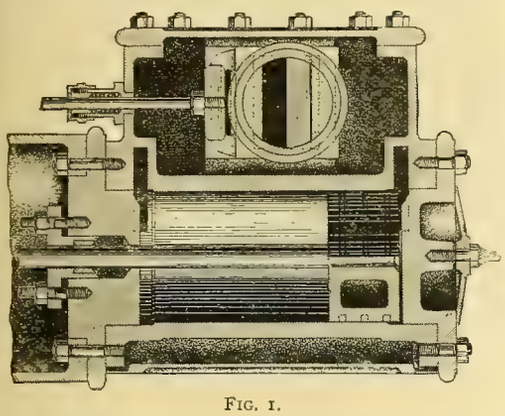


Fig. 1.

the sleeves connecting the two halves is the measure of pressure on these valves to hold them in contact with their faces.

The valve is not, therefore, a balanced valve, but relieved of much of the stress that would come on a plain single unbalanced valve. It is a light pressure valve.

Right here I should like to suggest that all valves should come under the classifications which are in accordance with the proportionate balanced to unbalanced area of entire valve. Thus it might be said of them that they are full balance, ⅞ balance, ¾ balance, ½ balance, ⅓ balance, and so on. The steam enters within the valve and exhausts into the steam chest, and is thence conveyed into the air or condenser from the lower opening, fig. 3. This valve is self-adjusting and runs with a light pull. The admission and release are rapid; the valve should be very durable and keep tight. There is not a good separation of live steam from exhaust steam, however.

Figure 4 is a view of the governor, which acts directly on the valve through its eccentric.

The leading feature of this governor is that it is influenced, not only by centrifugal and centripetal forces, but by the "pull of the belt" also. As will be seen, the governor is within and made a part of the belt wheel itself, and the construction is such that the resistance offered by the belt has a centripetal effect upon the governor weights—tending to pull them in toward the center of shaft. This construction allows the governor to "weigh the load." It may be so adjusted that the engine will run faster under load than without it, or just the same speed. The difficulty, when it occurs from this governor, is on account of friction and inertia. It will be seen that while variations in load are well provided for, there is no like provision for varying steam pressures.

1 From a Treatise on Leading Engines, by Ed. F. Williams.

An Electrical Device for Controlling Trains.

A Chicago inventor describes a plan by which train-dispatchers can secure absolute control of railway trains between stations, or, in fact, at any point along the road without the concurrence or even knowledge of the engineer.

The main part of the system consists of a

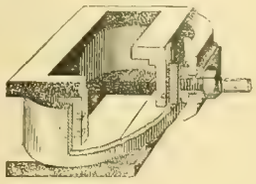


Fig. 2.

cast-iron box three feet long and four inches wide. These boxes are the same height as the rails, and are placed in the center of the track at intervals of about a mile apart on a straight road and at less intervals on a crooked road. When there are numerous grades a box may be placed on every summit. They are bolted to the ties. Inside the box is a flat steel spring with a hook on the under side, which holds it down. This hook is released by the train-dispatcher by an electric appliance very similar to the fire-alarm system in cities, where the horses are released and other machinery set in motion at a stroke. The electric wire will communicate direct with the train-dispatcher's office by means of the ordinary telegraph poles. When the spring is released, it forms an obstruction which is met by a device to be placed beneath every locomotive between the truck wheels. It consists of a bell crank with a small wheel at the extremity, so constructed that when it meets the spring a motion is created which is transmitted to the cab of the engine. This motion can be utilized either to set the air-brakes or to ring the bell. In either case the engineer has received warning of danger and stops his train.

Attached to the telegraph pole which conveys the wire from each spring is a box similar in appearance to fire-alarm boxes. The same touch that releases the spring also releases a target and ignites a fuse, which lights a ball of red fire and throws out minor balls at intervals, after the fashion of a Roman candle. Both these signals are to attract the engineer's notice, and there should be no portion of the road where one or the other could not be seen by the engineer whose train is in danger. These boxes are

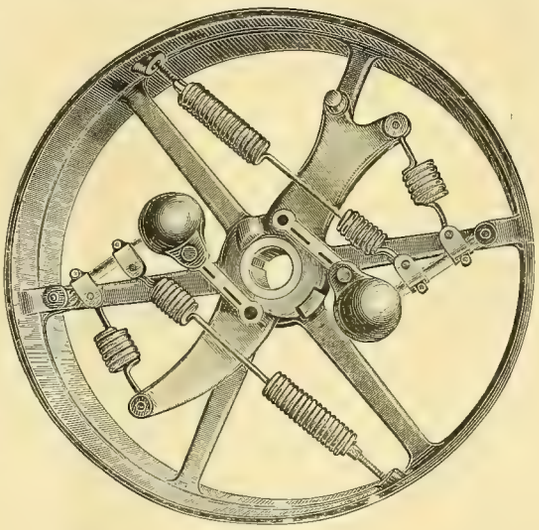


Fig. 4.

all provided with keys to be in possession of every employe, and by means of them immediate communication can be had with the train-dispatcher's office. The latter will contain a keyboard like a hotel annunciator, and the drop of a key will show the box on the line where the signal is from.

Suppose a train-dispatcher lets train number 1 leave a station by mistake and discovers that train number 2 has left the next station and will meet number 1 on the same track. He immediately releases all the springs between the two stations, and the same electric spark sets the two other danger signals in operation. The train-dispatcher waits for developments. One of the keys on his board soon drops, showing that train number 1 has stopped and the engineer is signaling from box 200. Another key drops and train number 2 is signaling from box 202. The dispatcher calculates which of the two is nearest to a siding, and signals back for that train to back up. Both trains have been controlled on a single track and a collision is averted.

The alarm boxes will form a complete system of railroad patrol. Section men, being provided with keys, can send a warning signal when they discover a settled bridge, a washout, a tree on the track, or any other obstructions. If a train is derailed or breaks down from any cause, the conductor will signal from the nearest box, and thus avoid the possibility of a collision in the rear. If another section is running behind and has left the last station, the dispatcher releases the springs and danger signals. These boxes can also be used by superintendents or road-masters for special instructions when they are out on the line.

Discharge of Electricity through Gases.

Professor Schuster, F. R. S., has made an im-

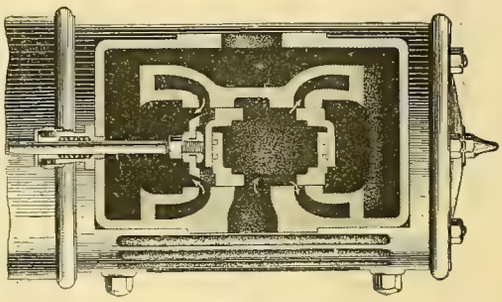


Fig. 3.

portant contribution to electrical literature in regard to the phenomena of the discharge of electricity through gases. The paper was read before the Royal society of England. The principal result established by his researches, deduces London *Electrician*, is the following: "A steady current of electricity can be obtained in air from electrodes at the ordinary temperature which are at a difference of potential of one-quarter of a volt only (and probably less); provided that an independent current is maintained in the same closed vessel." In other words, while a continuous discharge is passing through a vacuum tube the gas acquires the property of conducting crossways under an E. M. F., which, says the author, "I believe to be indefinitely small, but which the sensitiveness of the galvanometer I was using has prevented me from tracing with certainty below a quarter of a volt." He then shows that this leads to the important conclusion that "there cannot be a finite difference of potential between a gas and a metal in contact greater than that amount." This conclusion has generally been tacitly assumed in discussions of contact potential, and it is therefore the more satisfactory to obtain an experimental proof of its correctness. Professor Schuster accounts for the observed facts upon the following theory: "If the two atoms of a gas making up the molecule are charged by opposite electricities, but are held together in addition by molecular forces, a finite force is required to overcome the latter. But as soon as that force is overcome and the atoms themselves are set free to diffuse and constitute a current, these atoms will be able to follow any electro-motive force which we may apply. If, then, we have auxiliary electrodes, these electrodes will establish their electric field, which we can never screen off completely from any other part of the vessel except by closed surfaces. The atoms, with their positive and negative charges, will diffuse across to the auxiliary electrodes and give off their electricity to them. No finite difference of potential is required in the auxiliary electrodes, because even if there is work done in making an

atom interchange its positive for negative electricity, that work is undone again at the other pole, where atoms of a similar kind interchange negative for positive electricity."

Origin of the Edison Dynamo.

Amos J. Cummings, editor of the *Evening Sun*, of New York, tells an interesting story of the circumstances that originated in Edison's mind the idea of his dynamo. The story was recalled to the narrator by the fact that Edison's paper on the pyro-magnetic motor—substantially reproduced in the last number of the WESTERN ELECTRICIAN—was read before the American Association for the Advancement of Science, by Professor George F. Barker. Edison dislikes to make public addresses and therefore asked his friend to read the paper for him.

Professor Barker and Edison have been great chums for many years. The professor, though saturated with chemical lore, and an investigator and writer upon chemistry who stands in the front rank of students, is one of the jolliest of men. He doesn't look like a man who spends hours every day and night in a laboratory, reducing solids to vapors, and condensing vapors to solids, staining his fingers with acids, holding his nose to escape intolerable odors that he creates, and a master of all the curious symbols of the science as well as the maker of some of them. Away back in 1879 the professor and Edison became acquainted, and the acquaintance developed into the closest intimacy. To the professor Edison was a marvel. That a young man, bred only in a telegraph office, and earning a living at the key, should have not only mastered almost all the learning of the chemists without instruction seemed to Professor Barker almost incredible, more astonishing than Edison's genius for adapting his knowledge to practical purposes. "I can teach him nothing; he teaches me," said the professor once to the writer. This was not true. To Barker, Edison appealed always when in doubt, and no scientific mannerisms did either assume. In shirt sleeves, Edison with a quid of fine cut bulging his cheeks, and Barker, his face smeared with chemicals and his fingers of prismatic hues from contact with his acids and alkaloids, these two men of science would spend the hours at night till dawn came, talking in very colloquial and emphatic English. Sometimes they spent the night in Edison's wonderful workshop at Menlo Park and sometimes at the professor's laboratory in Philadelphia.

In the summer of 1879 Professor Barker was invited by the Wallace Brothers of Ansonia, Conn., to visit their manufactory and witness a large dynamo when put in operation. The machine was to be set running on Sunday. Barker asked if he could invite his friend Edison to come with him, and the Messrs. Wallace were delighted to have the famous genius with them. At that time Edison was known only as an expert electrician, and though his stock exchange ticker, his telephone, and one or two other inventions of that nature, had given him a great, and to him, valuable reputation with capitalists, it was with the phonograph, which was merely a curious toy, that he gained his remarkably popular reputation.

The electric light at that time was something that he had thought about, and he had determined to turn his attention to it at some future time.

Jammed into one of the little corner seats of the railroad car, a seat designed but for one, Edison and Professor Barker started for their visit, and there the writer found them. Edison wore a little half cotton sack coat, and Barker a black alpaca. Slouch hats half hid the faces of each of them. Edison declared that Barker, with his white choker, looked like a minister going to preach over Sunday.

"But he ain't," says Edison, "are you, professor? Some folks would say you are going to break it."

Then Professor Barker, casting his eyes on Edison's unblacked boots, remarked that no one would make the mistake of supposing that Edison was going to church.

"Though, perhaps, a good many think such experience would be good for him," he adds.

Thus jesting, as merry as schoolboys on a lark, these scientists made their trip, and they were going where Edison got his first valuable hints about the divisibility of the electrical current, and where Barker was to stand with the scientist's ecstacy and watch the mastery of men over the elements.

All of that Sunday Edison was very grave. He stood watching the revolutions of the great wheel, sometimes speaking not a word for hours, and Mr. Wallace afterward said Edison's face was a more remarkable thing for him to look at than the machine.

At dark Edison simply said to the professor that he had that day, he believed, obtained the suggestion that would develop the perfect electric light. He said but a few words. Barker understood. He said afterward that he knew that the remarkable man was on the eve of another invention which would be more striking than the telephone or ticker or quadruplex.

Edison set about the work at once of developing the electric light, and giving up all other business except that which his contracts required him to do, he figured out that in five years' time he would develop the perfect and divisible electric light. He did it in three. He could have done it in one, perhaps less, had he found the perfect carbon point.

The Edison electric light was invented on that Sunday in America.

The Isle of May Lighthouse Installation.

Before the British Institution of Mechanical Engineers on the 3rd ult., David A. Stevenson described the installation of the electric light in the lighthouse on the Isle of May. Said he: "Messrs. Stevenson, the engineers who had this project in hand, intended at first to use a compound wound Victoria dynamo, as manufactured by the Brush company, and giving a continuous current of 100 ampères at 70 volts for one automatic-feed arc lamp of 30,000 c.p. The Brush company were unable, however, to meet Messrs. Stevenson's wishes in the time given, and recourse was had to the alternating machines of De Meritens, two of which are now erected. On closed circuit each machine yields about 220 ampères at a tension of 40 volts, this representing an electrical energy of some 8,800 watts or 11.7 horse power in the external circuit. The engines employed to drive these generators are two in number, consisting of a pair of horizontal surface condensing engines, each with two cylinders 9 inch diameter and 18 inch stroke. They run at 140 revolutions per minute, and indicate 17.7 horse power each with 40 pounds steam pressure and 11 pounds vacuum. Single in place of compound engines were used, because they are less complicated and better suited for the less skilled attendance of ordinary light keepers. Steam is supplied from two Cornish boilers, one being in use whilst the other is held in reserve. They are both 20 feet long and 5 feet 6 inches diameter, with one furnace flue 3 feet diameter, 8 feet long, and six Galloway water tubes. The working pressure is 40 pounds. The coal consumption averages one cwt. per hour of lighting, which includes banking the fires during the day. The current is conveyed from the dynamo room to the lantern by means of copper rods 1 inch diameter, covered with a double waterproof wrapper. They are made in 14 feet lengths, the total distance being 880 feet. Three lamps of the Serrin-Berjot type are fixed in the lantern, one in use and two spare. The carbons employed have a diameter of 40 mm. or 1.6 inch; but 2 inches (50 mm.) carbons can be used when both machines are running. They have a graphite core, and are made by Siemens. Including waste, the consumption is at the rate of two inches per hour, and the power of the arc is about 15,000 candles when one machine is running. The dioptric apparatus designed by Messrs. Stevenson, and made by Messrs. Chance, of Birmingham, is of a novel description; the condensing principle being carried much further than previously. A three-wick paraffin oil lamp is kept trimmed and ready for use in case of an accident happening to the electric machinery. The total cost of the installation may be taken at about £22,435, and the average annual maintenance at £1,050. Comparing this cost with that which would have been incurred if oil were adopted, the author arrives at the following figures: The oil light may be estimated to cost 3.49 shillings per hour, and .00017 penny per candle power per hour, whilst the electric light costs 9.66 shillings per hour, or two and three-quarter times more, and .000038 penny per candle power, or less than one-quarter of what the oil light would cost per candle power.

That Los Angeles Electric Road.

Editor of the WESTERN ELECTRICIAN:

In your issue of the 23rd ult., I find the following:

"The electric railroads in Los Angeles, Cal., where the climate is considered to be the most suitable for them, are decided failures. One electric road, about one and a half miles in length, requires an engine of about fifty horse-power to supply the electricity of two cars, and, at this rate, is considered not profitable." So reads a stray clipping that has found its way to this office. There must be something decidedly wrong in the administration of this plant. With the meager data given, it is not possible to indicate the location of the defect, but the fact cannot be controverted that electric railroads can show many points of economy.

The falsehood first originated with a correspondent of the San Francisco *Call*, and was written in the interest of the cable road clique, who were jealous of the success of the electric road.

There was never "a mile and a half" of electric road run in Los Angeles. We waited until we had three miles constructed before we turned on the electricity, and it has been running from the first day, now more than seven months. We are now running nearly five miles, and expect within a few weeks to have ten miles running.

We have not had a "fifty horse power" engine. We have had a thirty horse power engine, which was used to test, and in view of the large increase of the system we are now putting in a two-hundred horse power. With our little thirty horse power engine, at times we have used three and four cars, carrying in a single day 2,300 passengers, most of them a distance of four and a half miles. We are carrying daily about 1,000 passengers, and will soon have an addition to our service whereby more will be accommodated. Hundreds of eastern visitors have ridden over the road, and they pronounce it a success.

The use of the system suggests many improvements, which are being added. There is but one opinion with men of good judgment, and that is electric power has come to stay. The road is operated under the Daft system, Leo Daft, of Greenville, N. J., being the inventor.

Should any of your readers wish any information on the subject I will be most happy to furnish it. CHARLES H. HOWLAND,

Manager L. A. Electric Railway Co.

Los Angeles, Cal., Aug. 5.

A Successful Small Plant,

A little Bowers dynamo furnishes the current, and is run by a small Shipman engine of two-horse power, writes a reporter, describing a plant of Liliputian size. The dynamo itself is but little larger than an ordinary waste-basket, and the engine occupies an insignificant corner of the room, running automatically hour after hour without attention, maintaining the same pressure and speed. This little plant runs fifteen incandescent lamps of sixteen-candle power each, of unusual steadiness, and the results prove that electric lighting in private houses is an accomplished possibility. In the same room, and operated by the same engine, is a similar dynamo, the Waterhouse, of little larger size, that astonishes many electricians, who have visited it by furnishing with two-horse power four arc lights of 2,000 candle power each, for it has always been accepted as a fact that a single arc light required about one-horse power. The same dynamo is also seen running thirteen incandescent lamps of sixteen-candle power, two of twenty-five-candle power, two of thirty, and one of 125, and one arc light, while it operates a sewing machine from a small electric motor with almost fierce rapidity. This dynamo is self-adjusting, and as the lights on the circuit are successively turned off the remaining ones are not affected in brilliancy or steadiness.

The Pennsylvania Railroad company is receiving bids for 200 arc lights to light its yards and tracks in Chicago, and for incandescent lights to light its depot building.

That Telephone Concession in China.

There has been considerable speculation about the importance of the telephone concession in China to a syndicate composed of Wharton Barker and other Americans. Speaking of this matter John Russell Young, ex-Minister to China, says: "The special telephone concession may have been granted, but it would be interesting to know the conditions. There were telephones in China long before I left there; an admirable system in all respects, and any concession would be for an opposition line. China has no patent laws, and in lieu of patents concessions are necessary. They are not given in a hurry or without adequate reason. A concession for a rival telephone line to compete with the China and Japan company now in existence would have about the same value as a concession to the Baltimore & Ohio to run their telegraph lines in Philadelphia against the Western Union. There are also thousands of miles of telegraph wire. I have telegraphed from Pekin to Washington and had a reply next day. The telegraph is under the control of the government. There can be no doubt that no country in the world offers better facilities for development than China, but all such advance must be governed by the laws which govern progress elsewhere. The Chinese are a shrewd, able people; there are no better business men. They are conservative because the conditions of life in a dense population especially make them so. It is one thing to develop 100,000 square miles inhabited by a few bands of roving Indians, as you will find the Rocky Mountain regions, and another to develop a province of 50,000 square miles with a population of 30,000,000 to 50,000,000. In all matters of development there will be an intense rivalry among the foreigners. All the money-making world seems anxious to lend money to China. If Mr. Barker and his friends have a concession, and I should be glad to know they have a good one, it was a mistake to allow it to go into the newspapers in this form. It has already attracted the attention of the House of Lords and will sharpen competition among other powers and alarm the Chinese, who will at once be put under pressure. In nothing is reserve of more importance than in transactions of this nature with China."

Settle's Electric Miners' Lamp.

Mr. Settle, the patentee of the water cartridge, by means of which dynamite is exploded harmlessly in fiery gas or in the heart of a barrel of gunpowder, is managing director of the Madeley Coal & Iron company, in Stafford. His inventive skill has been applied successfully to the illumination by electricity of the mines under his control, so that the miners do not even require hand lamps in their operations. One of the seams of coal, eight feet in thickness, is worked at a depth of 460 yards from the surface, and the wires are supplied with a current from an upper level 325 yards deep. Permanent lamps of 16-candle power are fixed throughout the workings at 60 feet distance apart. The small globe of glass which incloses the incandescent film is surrounded by a larger globe filled with water. The illuminant glass floats in this, and it is only when the globe is full of water that contact is established and light produced. As a matter of course, when the glass is broken contact ceases, and the water prevents any possibility of an explosion, complete extinction being instantaneous. These lamps are not affected by air-currents. In some of the pits the electric light is used for every part of the workings. Mr. Settle is also the inventor of an electric hand lamp, in which the same principle of safety is carried out by means of an outer globe with carbonic acid gas. On breaking the outer globe the light instantly disappears.

The renowned Comstock mines are to be lighted by electricity. One hundred arc lights and 1,500 incandescent lights will be used.

Measurement of Engine and Dynamo Speed.

By H. S. Carhart.

A mechanical speed counter integrates the number of revolutions in any given period, but gives no information respecting changes in speed occurring within the period covered by the integrating process. It is desirable to have a continuous record covering longer or shorter periods. Not only this, but if the record can be made to show the relative speed of two or more connected shafts simultaneously, it will teach us much respecting the slipping of belts, the relative value of pulleys of different styles, the effect of throwing off and on the load, etc. Such a record I have secured on a continuous band of paper.

The apparatus employed is the so-called "velocimeter" of Mr. F. W. Cushing. It was devised originally to measure the muzzle velocity of projectiles, and consists of two parts, a time-marker and a recorder. The first is a Gray's harmonic transmitter with a reed vibrating 150 times a second, and kept in vibration by electro-magnets. This reed opens and closes an electric circuit with each vibration. The second part of the instrument is a simple device for drawing a band of sensitized paper between three iron points or pens and a metallic wheel. The passage of currents through the paper produces blue marks by a well-known process. The manner in which the apparatus is used for the present purpose is represented in the diagram shown in Fig. 1, in which T is the time-marker, R the recorder, E the balance wheel of the engine, and D the pulley of the dynamo. The reed of the time-marker carries two light springs, one of which serves as an interrupter to keep the reed vibrating, and the other to open and close the second battery circuit through the middle iron pen. The three pens are connected, as shown, to the positive pole of the battery, while the metallic wheel is in connection with negative pole. The circuit of pen number 2 is carried to the engine, and of number 3 to the dynamo. At these two points insulating fingers are securely attached to the revolving axles in such a way that they separate momentarily two platinum pointed contacts at each revolution of the engine and dynamo respectively.

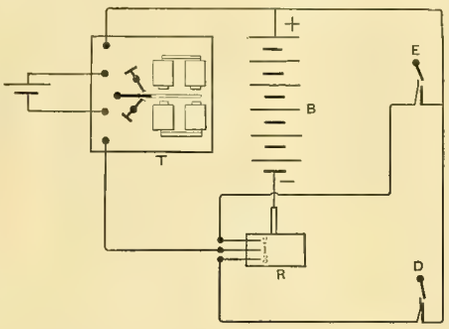


Fig. 1.

The band of paper, therefore, shows three discontinuous blue lines represented in Fig. 2, the central line composed of 150 marks a second, the lower one interrupted at every revolution of the engine, and the upper one showing a break at every revolution of the dynamo. The simple process of counting, therefore, gives all the information desired when the diameters of the driving wheel and the pulley are known. Any variation in the speed of the engine from instant to instant will be shown by a corresponding variation in the record. Any variation from uniformity not confined to a single revolution will be apparent upon careful scrutiny of the record.

A record is taken covering four or five seconds and inscribed on about eight feet of paper band. Every 150 marks on the middle line denote a second of time. If therefore we select two interruptions made by the engine near the ends of the paper band, and count the number of interruptions occurring in each of the three lines between these limits, the number in the middle line divided by 150 gives the interval in seconds, another shows the revolutions of the engine within this interval, and the third the corresponding revolutions of the dynamo. If there were no slip of the belt the ratio of the two speeds thus obtained would equal the ratio of the diameters of the driving and the driven pulleys. But this latter ratio will always exceed the former more or less. Closer inspection will show whether each revolution of the engine was made in the same time or not. A constant number of time dots between consecutive interruptions due to the engine indicates uniform speed.

A trial was made with a Ball 10"x12" engine driving a thirty-light Thomson-Houston dynamo running under something less than a full load. Four records, covering a period of about four seconds each, were taken at intervals of perhaps five minutes. The speed of the engine was found to vary from 298.3 to 302.5, and that of the dynamo from 905 to 914. The slip of the belt was about 2.25% increasing a little with the speed. The device is susceptible of valuable service in studying the transmission of power by belting. It leaves a permanent record, which can be studied at leisure. It is easily seen that the vibration-frequency of the reed is readily ascertained by connecting in the circuit of one of the pens a clock with seconds pendulum, which makes the circuit at each vibration and records a blue mark.

Fig. 2.—Measurement of Engine and Dynamo Speed.

Temporary Installation of the Storage Battery.

In Chicago at present there is a spectacular exhibition entitled the "Siege of Troy" at the base ball park. The grounds at night are lighted by sixteen Van Depoele arc lights. The engine in use is not large enough to take care of the arc lights and at the same same time an incandescent plant for lighting the dressing rooms. Recourse has therefore been had to the storage battery. Johnson, Holland & Co., supplied this part of the system of illumination. They put in thirty cells capable of supplying thirty incandescent lamps for six hours. The storage battery is charged during the daytime when the engine would otherwise be idle, and at night supplies the current to the incandescent system while the engine is running the arc plant.

The storage battery was originally charged from another circuit, carted to the grounds, and the cells were placed on a board on the ground, preparatory to being placed in the location they were to occupy when the play was ready for public exhibition. Meantime there was a delay on the part of the managers of the exhibition, and the cells for two weeks stood on the board and several times were subjected to drenching rains. Nevertheless careful tests at the close of the fortnight showed that the cells had suffered no appreciable loss of charge, and the first night of the exhibition they supplied the thirty incandescent lamps the full six hours for which they had been guaranteed.

The Woodward Storage Battery.

Last week in Detroit a public exhibition was given of a storage battery, devised by Henry Woodward, of London, England. The battery consisted of twenty-four cells, each fourteen inches long by nine and a half wide and fifteen inches high. Each cell contained eight lead plates, and the solution was composed of minimum and diluted muriatic acid. The weight of each cell was eighty-five pounds. The patents in the United States covering this battery are owned by a Detroit syndicate, consisting of Robert McKinstry, C. H. Thompson, E. C. Brown, Geo. S. Terry, Charles A. Warren, J. M. Farland, Thos. Williamson, James Ronald, Frank B. Preston, Wm. Foxen, Frank B. Trout, E. M. Washburn and N. T. Thurber.

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IN 1855, when the telegraph had been fairly established in England, for each telegram sent there were 439 letters. Ten years later the proportion was one telegram for every 151 letters. In 1875, the telegraph system of the country having in the meantime been purchased by the government, the proportion stood at one telegram for every fifty-six letters, and in 1886 it stood at one telegram for every forty letters.

THE temporary installation of the storage battery at the Chicago base ball park, mentioned elsewhere, shows only one of the many adaptations of this useful adjunct to electric lighting. The plan originally was to charge the battery every day at one of the stations of the Chicago Arc Light & Power company, carting the cells from the park to the station and back again. But the small engine in use at the park has been made to do double duty, charging the battery in the day time and running the arc plant at night, and thus the labor and expense of disconnecting and carting the cells back and forth have been saved. The practical demonstration that the storage battery can be successfully used in temporary incandescent light installations is interesting.

IT is evident from a statement made in our New York correspondence last week that the electrical exhibition to be given in New York this fall under the auspices of the New York Electrical society is bound to be successful. Applications had been received at the date of the letter for seven hundred horse power, to run 2,500 incandescent lamps, 200 arc lights, and 300 motors. This fact, when it is considered that the exhibition will not be publicly opened until Sept. 28th, assures the consummation of the wishes of the society for a large and complete exhibition of electrical apparatus. At the present stage of development of applied electricity, an exhibition of this character will be the source of much interest and information, both to experts and those whose vocations do not permit them to devote the necessary time to study to keep abreast of the phenomenal progress in the electric field.

SOME interesting facts in regard to the relative tensile strength and conductivity of silicon-bronze and copper were brought to the attention of the electric light convention in a paper read by Dr. Waldo, in which the use of copper line-wire with a silicon-bronze core was recommended. It appears that silicon-bronze can be produced having nearly the tensile strength of steel and of equal conductivity, which unites by fusion with copper when used as a core, and forms a more homogeneous structure with less difference of electric potential than when a steel core is used, while its fusion makes a perfect joint, excluding moisture, the intrusion of which with a steel core forms an electric pile, and causes disintegration between the core and its surroundings. The tenacity of silicon-bronze is also found to be superior to that of copper in resisting fracture when bent; and by varying the proportions of silicon and copper used in its manufacture the strength can be varied inversely as the conductivity.

THE paper on electrical education by E. L. Weeks, of Kansas City, read at the recent meeting of the National Electric Light association, presents a subject of the highest practical importance. The views are fully in accord with those already advocated in this journal, and are briefly as follows: The adoption by colleges and universities of departments of electrical engineering with properly equipped laboratories, where men can be educated as electrical experts; the course to embrace both preliminary and subsequent practice in the factory; reading rooms and libraries in connection with electric business establishments, furnished with electrical literature, where employes can acquire a scientific knowledge of their business, and examinations with promotions on the basis of the knowledge so acquired; associations and clubs where electrical subjects may be discussed.

To these various means of electric education should be added the evening lecture course for workmen and others, as already proposed by this journal. Lecture rooms specially devoted to this subject, and furnished with well equipped laboratories, should be provided, and the course should embrace the very best electric talent, and should be endowed and made free for all who choose to enjoy its benefits.

AN able presentation of the storage battery was made at the recent electric light convention by Mr. Mailloux and Professor Reckenzaun. It was shown that the battery has passed the stage of experiment, and fully entered that of practical utility, though much yet remains to be done to improve it; that its present status as to durability and economy is such that it can compete successfully with other methods for the supply of light and power, and become an important adjunct to the dynamo.

Professor Reckenzaun claims to have fully demonstrated that the motive power for propelling a full sized street car, fifteen hours a day, can by this method be supplied for $1.75, including all the expense of the engine and dynamo, so that the total cost does not exceed one-half that of the cheapest horse traction. The cost as compared with the cable system was also discussed, and it was shown that while not more than 20 per cent. of the power developed by the engine is utilized in propelling cars by the cable, at least 40 per cent. is utilized by the storage battery; while the cost and inconvenience of tearing up streets is entirely avoided. The disadvantage from the weight of the cells is largely obviated by using lighter cells for street-car traction than for electric lighting. It is found that the cells can be used advantageously from three to six hours at a time without recharging, while the time occupied in replacing discharged cells does not exceed three minutes.

As compared with the system which furnishes the electric current from an over-head conductor, the advantages are claimed to be decidedly with the storage battery.

As present indications are that the cable system is to be largely extended in Chicago, embracing the west side as well as the other divisions of the city, would it not be well for the car companies and city authorities to pause and consider the advantages claimed for storage batteries before tearing up streets and investing additional millions in the cable system?

IN the discussion of the alternating system by the electric light convention, some very interesting facts were elicited tending to show that alternating currents are far less dangerous than direct currents; several instances having been mentioned by different speakers where persons accidentally received shocks from 1,000 volt alternating current dynamos without serious injury, while shocks from constant current dynamos of the same capacity would produce serious, if not fatal, results. The physiological reason of this is not entirely clear, but it is probably due to the fact that the effect of the current in one direction is partially neutralized instantly by a similar current in the opposite direction; just as a succession of rapid, powerful blows on a wall, if equally divided between diametrically opposite points, and delivered alternately, would evidently prove far less effective in battering it down than if the same number were delivered on one side only.

The experience of the workman who received the 1,000 volt current for four minutes is interesting. It seems he was perfectly conscious for two minutes, but was unable either to relax his grasp on the wires or to speak, though suffering no pain. He describes the sensation as similar to that of drowning, and the treatment was the same as for asphyxia, and was entirely successful, so that on the following day he was perfectly recovered and ready for work.

ACCORDING to a London cable Henry Cecil Raikes, the English postmaster general, refused to consider a proposal to put in operation a system of half-rate telegrams to be transmitted during the night, as is done in this country, on the ground that he did not think it advisable to try any new experiments, or to consider a proposal to discuss the subject of long-distance telephony. In regard to the latter, he declared that he very much doubted the advantage of a system enabling conversation to be carried on between the great towns of England. The present system of communication, he said, had hitherto sufficed, and he could see no reason why it should not answer for the future.

Judgment as to whether a long-distance telephone system would prove advantageous could be much better formed after a trial between even two of the more important cities, and which could be made at a comparatively small expense, than without any trial at all. That the present system has sufficed for the past, and that it should answer for the future is equivalent to refusing to receive the electric light because the tallow dips of our ancestors sufficed for them, and should answer the purposes of the present generation. The cost of telegraphing in England is low, and it may be that half-rate messages would bring the revenue so close to cost that operation of the lines would be unprofitable.

PROFESSOR Carhart's article on the velocimeter and its record of the variation in speed of an engine and dynamo form an interesting feature of the current number and will be appreciated by mechanical engineers to whom an exact record of the performance of an engine is a necessity. That an engine will vary in speed to a greater or less extent at different times, even under seemingly similar conditions is a fact well-known to every engineer. The method of ascertaining that variation, as usually followed, consists in applying the speed indicator not once or twice or a score of times, but times enough to assure the one making the test that he has records that will enable him to determine by an average the percentage of variation. This test is a long one and exceedingly tedious. The velocimeter now comes to the aid of the engineer, makes a graphic record of the performance of both the engine and the pulley to which it is belted, makes that record by seconds—not minutes—and gives the data for a simple calculation of the percentage of belt slip. We have reproduced the record made by the velocimeter on a block and show the performance of an engine and dynamo for several revolutions, the longer lines at the bottom representing the engine pulley, the shorter lines at the top the dynamo pulley, and the continuous line of dots between representing the time, that is, 150 dots representing one second of time. We need add nothing to Professor Carhart's clear description of the apparatus and its working, except to commend it to the attention of our readers.

The proclamation just issued by the Mandarin Kung to the people over whose lands the railway from Taku to Tientsin will pass may be said to complete the arrangements, so far as the authorities are concerned, for constructing the first Chinese railway. Properly speaking, the short

experimental line from Shanghai to Woosung, made by English capitalists some few years ago first introduced the iron horse into China, but that line was promptly bought up and destroyed by the Peking government. It is the change that has come over the ruling powers in China in regard to railways which gives so much importance to the projected line from Lutai to the south bank of the Peiho, at Tientsin. The recent hostilities with France did more to bring this about than anything else, although the introduction of railways into the country had been under discussion for some years before. In the proclamation referred to above, mention is made of the memorial on the subject drawn up by the board of admiralty and approved by imperial decree. Li-Hung-Chang is a member of that board, and has long been favorable to railways; but the head of it is I-Huan (the seventh prince), and it was his conversion to the idea that has brought it to fruition. He has acknowledged that his views were at one time opposed to the innovation; but since the recent hostilities, and more particularly since he made a personal visit to the northern seaports in company with his colleagues, he has become aware that "these adverse opinions are not in accordance with the true interests of the state." The usefulness of railways in transporting troops and material for the defense of the coasts and frontiers of the empire is the chief consideration in the estimation of the Peking authorities; but lines of railways once constructed in China may be trusted to demonstrate their *raison d'etre* from the trade and traffic point of view.

When once the Chinese people are reconciled to the idea of railways, a new period of prosperity will probably open up for the iron and steel founders of this and other countries. Throughout China, telegraph lines are now almost universal. Mr. Fulford, in the recent report of his journey through Manchuria, speaks of their rapid extension in that outlying portion of the empire. They are being constructed for military purposes, but they are available for ordinary use. Mr. Fulford himself got an answer from Peking in the course of a few hours to a message sent from Ninguta, which shows that even the outlying telegraph lines are in good working order. Railways, like telegraph lines, may owe their introduction into China to military considerations, but when once their advantages as main arteries of trade and communication are generally understood their acceptance will doubtless be universal. At the same time there is a great deal of prejudice to be overcome, and that the Peking authorities are conscious of it is shown by the cautious wording of the memorial, of the imperial decree, and of the proclamation informing all whom it may concern that the construction of the Taku-Tientsin line is about to be begun.

Sooner or later the Chinese will be large purchasers of railway material, and no amount of foreign competition can prevent this country from getting a large share of the trade. But what English merchants have to look to is that they get a due proportion of the business from the first. The French have the start already, and the Germans have been bringing financial and diplomatic influences to bear in order to secure a commanding position in Chinese railway enterprise. The Americans have to be counted in, as well as the Belgians.—*St. James' Gazette.*

The active influence of German diplomats in securing trade for German manufacturers is a factor that enters commercial dealings with other foreign countries than China. It has shown itself frequently in trade with Japan, while consular representatives of the United States are not permitted to use their diplomatic influence to turn the tide of trade toward America. The higher cost of American goods compared with English goods is another factor that tells against the growth of American trade with China. But, if American products can be sold in English colonies against English or any other foreign goods solely on the ground of superior merit, America need not fear that it will not secure its share of trade with China. Particularly is this so in the line of electrical appliances. America leads the world in this respect, and when the time comes for a more extensive adoption in China of the electric light, the electric motor, the telephone and the telegraph, America will be represented and well represented in that country.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number VIII.

The Weston Dynamo Continued.—The field magnets of the Weston dynamo are shunt wound, the circuit by which they are excited being entirely independent of the lamp circuit, as explained in No. IV of this series. The pole pieces are partly divided into sections by a number of vertical openings, as shown in Figure 20, and their projecting lips approach more closely in the center of the armature than at the extremities; an arrangement which, it is claimed, has an important influence on the magnetic intensity of the field, tending to produce greater uniformity of inductive action. The pole pieces are placed one above and the other below the armature as shown, and have opposite polarities; each pole piece connecting the similar poles of two horse-shoe magnets, placed one on each side of the armature; the two north poles being joined to the upper pole piece, and the two south poles to the lower pole piece. By this arrangement a complete magnetic circuit is obtained with "consequent" poles, as they are termed, above and below, and the magnetic resistance is reduced to its minimum. Formerly each magnet had six cylindric cores, three above and three below on each side, twelve in all; each core being wound with a separate coil, and all the coils joined in series; but, in the later styles, one elliptic core has been substituted for each set of three, making two for each horse-shoe magnet, each

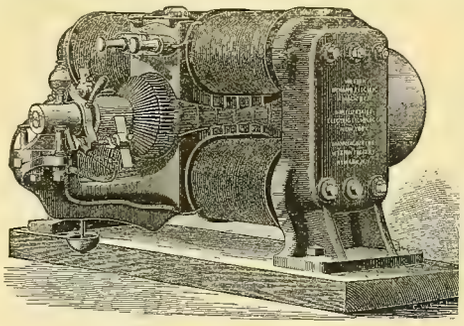

Fig. 20.—the weston dynamo.

pair extending horizontally on opposite sides of the armature, being joined to a vertical iron yoke at their outer extremities, while the inner extremities are joined to the pole pieces as already stated; the coils, joined in series, being traversed by the entire current.

In this dynamo, as in the Edison, massiveness in the cores and pole pieces is a prominent feature, while the vertical sections into which the pole pieces are divided tend to prevent the formation of Foucault currents. The complete magnetic circuit with consequent poles is a feature of several different dynamos, and was first introduced by Gramme.

The drum armature with longitudinal winding, found in the Edison and Weston, is also a feature, common to several different dynamos; this method of winding having been first invented by Siemens, and the drum form of armature subsequently by his partner, Von Hefner Altneck. Its chief advantage consists in utilizing the magnetism of the field more fully than any other style. In the ring armature, as has been shown, a certain percentage of the lines of force cross the interior of the ring, and do not pass through the coils; hence not only is their magnetic effect lost, but their inductive action must, to a certain extent, oppose and neutralize that of the lines passing through the coils. But in the drum armature it is evident that every line crossing the space occupied by the armature must be included within its coils, and that the only loss would be from lines passing outside.

The brushes of the Weston dynamo consist of a number of flat copper strips over-lapping each other, each strip being divided into three tongues. They are attached to a yoke, which can be rotated by hand so as to change their position on the commutator with reference to the magnetic intensity of the field, and thus vary the strength of the current. The armature being wound with two circuits, as described, each attached to an alternate segment of the commutator, it is impossible for the coils to become short-circuited and over-heated by an accidental connection, from copper dust or otherwise, between two adjacent commutator segments.

The internal resistance of this dynamo, both magnetic and electric, being reduced to the minimum, and the counterpoise between the lamp and field magnet circuits very nicely adjusted, ninety-nine out of a hundred incandescent lamps, fed by its current, can be instantly extinguished without perceptibly affecting the light of the remaining one.

The Melting Platinum Standard of Light.

M. Violle, in a statement which he has recently submitted to the Académie des Sciences, deals with the comparative radiations from melting platinum and melting silver. One of the metals was introduced into the little decimal lamp of Dr. Siemens, which consists essentially of a box pierced with a hole one-tenth of a square centimetre in area. Immediately behind this hole is the metal in the form of a thin ribbon traversed by a strong current of electricity, which is raised in intensity until the point of fusion of the metal is reached, when its radiant power can be observed. In this way M. Violle found that the total radiation from melting platinum is fifty-four times that of melting silver. This ratio of total radiant energies, while very considerably on the side of the platinum, is yet much lower than the ratio when luminous radiations only are compared, in which case it is as much as 1,000 to 1. In the course of his observations M. Violle admits that Mr. Methven is correct in stating that in all flames there is a region of constant radiant intensity. For his own experiments upon the comparative luminosity of the radiations from molten silver and molten platinum, M. Violle employed, as an intermediary, the Hefner-Alteneck amyl-acetate lamp, and which, according to his determination, is related to the other photometrical standards by the ratio as follows: 1 Siemens=1.95 Hefner=.832 Methven=.208 Carcel=.1 Violle. Thus the radiation of light from a square centimetre of molten silver is less than .02 Hefner-Alteneck. W. J. Dibdin, in his report on photometry to the Metropolitan Board of Works, to which we referred last week, gives the following description of his method of working with the platinum standard: "Unfortunately I have been unable to try the precise plan suggested by M. Violle for obtaining a standard from platinum at its melting temperature; but in lieu of this I have tried a device which gives promise of practical results. The method adopted was to heat to its melting point, by means of an oxy-hydrogen flame, a piece of platinum foil placed behind a steatite screen perforated with an aperture smaller than the portion of platinum actually incandescent. This arrangement, while simple in operation, has afforded very promising indications, and seems well worthy of further experimental observation, as there can be little doubt but that an easily worked and reliable system for obtaining a steady light from molten platinum would find ready acceptance as being definite for all time. When working by this method, the oxy-hydrogen flame is gradually increased in intensity until the platinum foil melts. When this happens the oxygen is turned off, and a fresh portion of foil, which is carried on two rollers, one on each side of the aperture, is brought into position, and a second experiment made; and thus successive readings obtained, if necessary, in rapid succession. The foil is wider than the portion actually perforated by the intense heat, so that by turning a winch-handle, a fresh surface is almost instantly obtained. The operations involved in testing are thus about a quarter of a turn of the winch-handle, and turning the oxygen on and off at the beginning and end of each test respectively. The aperture in the steatite screen is about one-fifth of an inch in diameter, and allows light equal to a little more than two candles to pass to the photometer disk. While the proposition to obtain a standard light by this means is theoretically satisfactory, and the preliminary practical results have been very promising, the details are as yet insufficiently worked out to compete against more established systems."—*London Electrician.*

Cellulose for Galvanic Batteries.

M. P. Germain, the original inventor of cellulose armor, has invented a substitute for the porous jars in galvanic batteries, writes Lieutenant W. H. Beehler of the United States navy to *Mechanics*. This substitute is a by-product from the manufacture of cellulose armor. It differs from the armor cellulose in its preparation and chemical combination. Its production is complicated. The raw material is first separated from the inside husks of cocoanuts, which are used for making armor cellulose. It is then combed, reduced to powder and freed from all soluble foreign substances. The resultant product is paracellulose and vasculose, with small quantities of mealic and oxalic acid. It resembles cocoa powder in color and appearance. It has a very low specific gravity, .08, and can be easily compressed in the hand to two-thirds of its volume, when its specific gravity is .22; therefore three or four times lighter than sponge. Its capacity for absorption far exceeds that of any other known substance. One volume will absorb an equal volume of liquid, and the resultant volume is inappreciably greater than that of the liquid alone. One result of this complete absorption is to prevent any noticeable increase in the electrical resistance of the liquid, a fact fully substantiated by experiments. The most important application of this cellulose is in its adaptation to the Le Clanchè element. The following description of a crosse moist Le Clanchè cell will serve to illustrate the manner in which cofferdam cellulose may be used for galvanic batteries. This cell consists of a pine box soaked in paraffine, and coated on the inside with mastic composition. In setting up the cell the box is turned upside down and a layer of the usual mixture of coke and manganese is evenly laid in the bottom. A block of conglomerate carbon is then laid in and covered by a second layer of the mixture of coke and manganese. The remaining space is filled with the cofferdam cellulose, brim full, up to and a little over the top. A good amalgamated zinc plate, or, preferably, a number of thin zinc plates are then laid on the cellulose, which had been previously subjected to pressure and heat, to absorb one-half its volume of the solution of sal ammoniac. These zinc plates are screwed on the box, to fit tightly, and this necessary pressure suffices to moisten the electrodes and to keep them moist. The use of a number of thin zinc plates permits better amalgamation of all the mass of zinc, because each of the plates is amalgamated separately, and they are from .12 to .2 of an inch thick. The outer surface of the zinc plates is shellacked to prevent oxidation. The plates lie on each other and are united to a common pole piece, which is also amalgamated. The pole set-screws are secured to the electrodes through small slits in one side of the box.

The cell thus set up may be used in any manner whatever, and in transportation is not liable to injury, as a fall of five or six feet will not injure it. But while it may be used in any position, the best results will be obtained when the cell is placed with the zinc plates on the bottom. In this position the weight of the superincumbent mass of coke and manganese will exert a pressure on the cofferdam cellulose, so that its absorbed solution will be allowed to exude and thus keep the electrodes moist. Small holes should be bored into the top of the box—the side opposite the zinc plates—so that the gases may escape, and it is also advantageous for depolarization to have the manganese coke mixture in contact with the air.

The electromotive force of this cell is about 1.5 volts, the same as that of a freshly set up Le Clanchè cell. Its electrical resistance, for the given surface and distance between the electrodes, is as that of an ordinary Le Clanchè cell. The following advantages are claimed: 1. This cell has much greater electro-chemical capacity for the same weight and volume, because the necessary space is utilized more completely. 2. The formation of insoluble chlorides is much slower than in ordinary Le Clanchè cells, and the increase in the electrical resistance is thereby delayed. This property is due to the fact that the exciting liquid is thoroughly protected from evaporation, and that a completely saturated or warm concentrated solution of sal-ammoniac may be used. 3. The waste of zinc is avoided by having thin plates of zinc thoroughly amalgamated. 4. It also has the advantage of being light, compact and strong, so that it may be used for military telegraphy, balloons, and on board ship.

The cofferdam cellulose is used in other varieties of galvanic batteries and also for accumulators.

The Board of Trade's Victory.

The prolonged fight between the Chicago Board of Trade and the bucket-shops seems to have been terminated finally in a victory for the Board.

When it had secured the passage of a law prohibiting the bucket-shop system of trading, the Board of Trade held the key to the situation as far as the state of Illinois was concerned. But being restrained by the court from refusing quotations to most of the city concerns it could not at first prevent their transmission over a network of private wires from these bucket-shops to all the others in the country outside of the state. In this way the shops, having injunctions, though they could not do a dollar's worth of business in their own offices, gained a large and steady revenue from the outside concerns they kept supplied with quotations. After the passage of the law President Wright set to work industriously on behalf of the Board, and proceeded to draw the circle closer about the contraband concerns. First he went to the Western Union. That company had the choice presented to it of discarding its valuable bucket-shop trade or of losing the trade from the big Board. The former alternative was chosen and the favor of the Board was retained. Then the Postal Telegraph company was virtually ordered to take its wires out of the bucket-shots. Compliance not being evident, the Board withheld its trade from that company and uprooted its instruments. The Postal Telegraph company then decided to cut off its bucket-shop trade. A week ago the Baltimore & Ohio Telegraph company received the same command that the Postal had had a short time before and failing to comply, its instruments were thrown out and it, too, lost the big Board's trade. But Monday that company swung into line with the other telegraph companies and for the present, at least, the bucket-shops are without telegraphic quotations.

The Electric Light in the Orient.

H. M. Williams, who has recently returned from the Asiatic empire, where he went to introduce the electric light, says that the readiness with which the orientals adopt these improvements is quite astonishing. In Japan, most of the principal cities are now lighted by electricity, and most of the finest houses are illuminated in the same way. A large plant has recently been placed in the palace of the mikado, at Tokio, a very large building, or rather a cluster of buildings, connected by corridors and covering several acres. The Chinese do not take hold of these improvements as readily as the Japs, but are beginning to see their advantages. The Coreans are ready to adopt all modern ideas, particularly if they come from the United States. The palace of the king of Corea has a plant of 300 lights, and was first illuminated on the birthday of the king's mother-in-law, on the twentieth of February, with great ceremony. The palace is at Seoul, and consists of a series of long, low, wooden buildings, with a thatched roof. As no foreigner is allowed to look upon the features of the king or queen, the workmen took great risks when they were putting in the apparatus, for if they had, even by accident, seen the face of the king, they would have been put to death, according to the custom of the country. They were carried into the palace and through the corridors in palanquins, and trumpeters were sent ahead of them, so that the royal family might keep out of their way.

Conference of Cable Men.

There will be a conference of cable men at the office of E. J. Hall, Cortlandt street, New York, September 7th, to discuss the best method of making telephone cables. W. R. Patterson of Chicago will attend and represent the Western Electric company.

English Telegraphers.

In their recent annual conference the English telegraphers adopted the following platform:

That entrance into the Postal Telegraph service depend on open competitive examination, of which due notice be given to the public; that the maximum salary for an operator be £200 per annum; that classification be abolished; that probationers be entitled to have their appointments confirmed, on passing a fixed qualifying examination in conduct and proficiency, at the termination of the probationary period; that the increments from the minimum to the maximum shall be as follows:—12 shillings by 2 shillings per week per annum to 20 shillings per week; then by 2 shillings 6 pence per week per annum to £200 per annum; that an immediate increment of 5 shillings be granted to all present second-class clerks who entered the service prior to the application of the Fawcett revision; that promotion to superior appointments be by efficiency, conduct, and seniority, and not by selection or seniority alone; that the senior officer in a class be entitled to appointment to a vacant superior post, on passing a qualifying examination in such knowledge as will fit him to perform the duties attaching to such superior post, the standards of examination to be fixed and publicly known beforehand; that seven hours constitute a day's labor for telegraphists; that all duty performed on Sunday, be performed as over-time; that over-time pay be at the rate of time and a quarter; that over-time pay be calculated at the rate of forty-two hours per week; that telegraphists with less than ten years' appointed service receive twenty-one days' annual leave; that telegraphists with ten years' appointed service and upwards receive one calendar month; that superior appointments in the postal departments be open to officers of the telegraph department; that the engineering department be amalgamated with the commercial branch; that a telegraphist doing temporary supervising duty shall receive while so occupied the minimum salary attached to that duty; that retirement from the postal telegraph service at the age of sixty be compulsory.

Mexico's Progress.

The American railway invasion of Mexico began in 1880. The railway mileage of that country was then about 500 miles, consisting chiefly of the English line from Vera Cruz to the City of Mexico. To-day, says the San Francisco *Bulletin*, there are in round numbers 2,700 miles of American railway in operation, and additional work is in progress or projected. About $120,000,000 have gone into these enterprises, and nearly as much more into telegraph, tramway, land and colonization, mining and other companies, which have followed the railways. These amounts measure the confidence of American capital in the future of Mexico. The Mexican people have individually shown less faith in themselves by refusing to invest in railway securities. Mexican aid to railways has come from the government, not from the people directly, and has been attended in most cases by glaring bad faith. Whether Mexico has justified American confidence by her response to its advances is a question to be answered by facts and figures of progress. Before the railway era Mexico was almost isolated from the business world by the slowness of communication. Now it is in telegraphic and daily mail and express connection, and the city of Mexico has the same banking and exchange relations with the world's centers as the great cities of the United States and Europe. Internal peace has followed and favored the progress of lines of communication. The commercial and industrial development of the country has gone forward, slowly, according to American ideas, but rapidly compared with previous Mexican experience. The increase of railway earnings is one proof of this statement. It has been steady from year to year. The government revenues offer another proof. They have advanced from $17,800,000 in 1879 to $33,000,000 in 1886–87. The budget for 1887–88 is based on an estimate of $36,000,000 income. This advance is due both to customs and internal revenue.

CORRESPONDENCE.

New York Notes.

NEW YORK, Aug. 26.—The new bids for electric street lighting in New York city were opened by the Gas commission on Wednesday. Seven bids were received, mostly for new territory, but they did not cover the whole of such portions of the city as are still lighted by gas. The commission had hoped that such would be the case, but if they had looked into the matter a little further they would probably have ascertained that public lighting by electricity in territory where there is no demand for private lights is not eagerly sought for at 25 cents per night. A company securing a contract and putting up wires at considerable trouble and expense, only to find itself underbid at the expiration of the year, might be performing a work of charity for the city, but it would not be good business management. The Ball company instead of putting in a bid, filed a protest, claiming that the specifications were such that only the United States company could comply with them. This statement was disproved by a long report from Lieutenant Millis, who is an electrical expert, enjoying the confidence of Mayor Hewitt. Other companies bidding for the lighting at prices varying from 25 to 50 cents per night were the American Electric Manufacturing company, the East River Electric Light company, the Harlem Lighting company, the North New York Lighting company, the Mount Morris Electric Light company and the Brush Illuminating company. After reading the bids the secretary of the commission was instructed to prepare a schedule showing the exact territory which each company proposed to cover, and present it at the adjourned meeting to be held next Thursday noon.

Stephen D. Field has been unfortunate in his proposed test of his new motor the "Yonkers" on the elevated railway. Everything had progressed favorably, and the motor had been moved just enough to test the connections and prepare for service, when on Wednesday there came up a thunder storm, during which the generator at Twenty-fourth street received a charge of nature's electricity which so damaged it that possibly two weeks will be required to make the necessary repairs. The dynamo has a capacity of 200 ampères and 1,200 volts running at 1,000 revolutions, developing a maximum of 120 horse power in the motor. Much interest is being taken in this demonstration, and Mr. Field will be heartily congratulated if his experiments culminate in practical success.

A gentleman who has just visited Philadelphia for the purpose of examining the electric street car, driven by eighty cells of storage battery, under the supervision of A. Reckenzaun, pronounces it an unqualified success so far as operation is concerned. The car was stopped and started on a 10 per cent. grade without difficulty, and showed itself to be far superior to a horse-car in the control of its movements under all circumstances. Mr. Reckenzaun is satisfied, however, that he can obtain equal power from motors of half the weight, and two have been ordered from Europe with which he will replace the present motor and fit up an additional car, both of which will be placed in actual service.

Considerable opposition is being developed among the property holders at New Brunswick, N. J., against the proposition to use an overhead system for the electric railway in that city. Opposing interests have no difficulty in securing electrical experts who are willing to testify that it is not necessary to erect poles and wires along the railway line, so that it appears somewhat doubtful if the consent of the property holders can be readily obtained.

The Edison Electric Illuminating company had a little experience with a strike at the central station, 257 Pearl street, on Thursday. The trouble arose from the difficulty experienced in dividing up a twenty-four hour day into two working days of ten hours each. The problem is sometimes solved by dividing the time into three eight hour "tricks," while in other cases economical managers prefer to split it into halves of twelve hours each. It was the latter division which fourteen employes objected to, and although the Edison companies have the reputation of dealing fairly with their men, there was a breach of discipline in this case, and the men knocked off, only to return next day, as their limited number rendered it an easy matter to supply their places.

Among the creditors of the firm of Henry S. Ives & Co., whose recent failure has been a sensation in financial circles, appears the name of J. H. Wade, of Cleveland, who is said to have sold Mr. Ives a controlling interest in the Cincinnati, Hamilton & Dayton railroad, for which he accepted three notes amounting to $700,000. Mr. Wade, who retired from the presidency of the Western Union Telegraph company with an ample fortune eighteen years ago, is well known in the west. The failure of Ives & Co. was followed by that of Groverteen & Pell, George H. Pell, of the firm, being vice-president of the Commercial Telegram company, which for many years has successfully maintained a quotation system in opposition to the Gold & Stock Telegraph company. It was reported that the firm was largely interested in the Commercial company, and that it had sold 2,000 shares of the preferred stock.

Another subway has been started at the corner of New Church and Rector streets, which it is presumed will accommodate the telephone wires from the vicinity of Wall street, leading up to the telephone building on Cortlandt street. The ducts of the new conduit are made of heavy sheet iron with a riveted seam and lined inside with cement, having a diameter of two and a half inches, the same as those laid on Broadway. There appears to be no satisfactory method of making secure joints between the ends of the pipe, but as none have been placed in position, this is given as an opinion which may require subsequent correction. P.

From the Pacific Slope.

SAN FRANCISCO, August 20.—Two new hotels are being built at San Luis Obispo.

The salary of the electrician of the city of Oakland has been raised from $125 to $150 per month.

August 11th a powder explosion took place at Fleming's Point, Cal., which shook the earth and made the residents of San Francisco, Oakland, Alameda and surrounding towns think that an earthquake was in progress. The damage amounted to about $25,000. Vagrant electricity, as it is termed by the powder people, is said to have been the cause.

The piston rod of the engine at the electric light works at Marysville, Cal., broke on the 13th and tore the cylinder head off the engine and a hole through the end of the building. The engineer escaped injury. The stoppage of the engine causes a good deal of inconvenience to those dependent on the electric light for illumination.

Victor Scharff, of San Jose, whose trunk caught fire at the depot at Sacramento and was found to contain chemicals, which caused an infernal-machine scare, explained to Deputy-sheriff Lee that he was an architect and electrician of San Francisco, and that he used the tools and chemicals he had in his trunk in experimenting. By the breaking of the phosphorus bottle his tools were destroyed, and he had suffered other loss.

A telephone line has been established from Yreka to Montague.

Tacoma is to have a $2,000,000 smelter. A company has been formed of eastern capitalists.

A gas explosion in the vault in the comptroller's office at the capital in Sacramento seriously injured the clerk.

The Oceanica Steamship company, plying between San Francisco, the Sandwich Islands and Australia, have concluded to do away with electricians on board their steamers. Hereafter the oilers will attend to the dynamos.

S. A. Bishop and Jacob Rich are building an electric street railway from Santa Clara to San Jose and East San Jose, and have asked for a franchise for another road from Coyote bridge easterly along the Alum Rock road to King street, a distance of four miles.

A telephone exchange has been opened at Walla Walla, W. T., with forty-two subscribers.

C. A. Fish, of Sacramento, is about to start for the Yosemite Valley to put in the annunciator for the Stoneman hotel, which was built by the state. Mr. Fish reports trade very lively this season. He has secured the contract for supplying the new Fresno hotel with all the latest improved electric apparatus. The cost of the hotel will be $100,000. S.

Indianapolis Items.

INDIANAPOLIS, Aug. 28.—The street commissioner of South Bend, by direction of the city council, commenced August 24th to cut down the lines of the Central Union Telephone company, but was enjoined after two poles and some twelve wires had been cut. The action by the council was in consequence of the telephone company discontinuing telephone service for a monthly rental, and the refusal of a number of former patrons of the company to accept service under the toll system. Pending service of the injunction, the cutting of poles and wires at different points was continued until a number of routes were destroyed. Several arrests have been made of persons connected with this trouble.

Suit was begun last week against the Central Union Telephone company by the state of Indiana, in which a demand is made for $40,000 back taxes and penalties. In 1881 a law was enacted by which foreign telephone companies doing business in the state were required to report to the auditor of state between the first day of April and first day of June of each year their gross earnings for the year immediately preceding April 1st, and at the same time pay to the treasurer of state the sum of 25 cents for each $100 of the gross receipts. It seems the Central Union people have not complied with the law, in consequence of which the attorney-general has brought suit. The complaint has been carefully prepared, and it is the intention to test the law and see if corporations can be compelled to obey it. The attorney-general is also looking after the affairs of another company operating in the northern part of the state. M.

Detroit's Budget.

DETROIT, Mich., Aug. 29.—The American Bell Telephone company has filed bills of complaint against the following persons: Richard Winsor et al., Port Austin; Matthew D. Wagner, Sand Beach; David Donahoe, Emmet; J. Jenks & Co. et al., Sand Beach; David James Stephenson, Port Huron; Robert Campbell, Adams Corners; Alexander Pike, Ubly; Otis Ellsworth Kenley, Tyre. The Cushman instruments are in use. The four last named defendants are agents for the St. Clair & Sanilac Telephone Co.

The Van Depoele Electric Railway Construction Co. is building a road at St. Catharines, and will equip it with its motors. The company says this road is the most difficult one it has yet constructed, the track running over several steep grades and around some awkward curves.

The Jackson city council has resolved to contract to light the city with 180 Thomson-Houston arc lights for $16,000 a year. The mayor has decided to veto the resolution. He says the $9,000 appropriation made will be exhausted before the fiscal year ends with the present system of lighting, and there is no way to get the other $7,000. The council claims it will pass the resolution over the veto, in which case, the mayor says, he will not sign the warrants for the pay. Some trouble is promised before the matter is finally disposed of. C.

THE ELECTRIC LIGHT.

It is expected that the electric light in Chitopa, Kan., will be in operation in less than ninety days.

The Parsons, Kan., electric light system will be in running order Sept. 15th.

A wind motor designed for use with a electric lighting plant is one of the latest devices. The idea of the inventor was to make a motor that would drive a dynamo to charge accumulators and do its work without any attendant.

After a successful test of incandescent lights in the Hoosac tunnel recently, a Boston company made arrangements for a test of the arc light, to which the railway officials acquiesced. The line was therefore extended from the incandescent light eight hundred feet farther into the tunnel and nine arc lights were hung on the sides of the tunnel two hundred feet apart. They alternate,

however, so that while they are two hundred feet apart on either side of the tunnel, yet the second light is only one hundred feet from the first, on the opposite side and so on. The work of starting the lamps has been delayed somewhat, owing to the lack of power, but an engine has been set up, and the test will be made in the presence of officials of the road. The incandescent system has been run very successfully for two months.

The large new cotton mills of the Peel Spinning company, limited, at Bury, England, have been supplied with a complete electric light system. The installation comprises some 500 lamps of the Weston type with wavy filaments. The current is obtained from two shunt wound Weston dynamos, one of which is driven by a separate horizontal engine of twenty-five indicated horse power, and the other by means of a countershaft and rope pulley from the large mill engines. Each machine supplies current for some 250 lamps, the whole number being alternated as usual; so that in case of any accident occurring to one dynamo, the other is still able to sustain sufficient lamps for carrying on the ordinary mill work. The engine power is divided in the same way to attain this end.

The property committee of the common council of Rochester, N. Y., has been instructed to investigate the advisability of purchasing a dynamo for use in lighting the city hall. The present cost of lighting the building averages over $2,000 a year.

Beloit, Kan., will put in the electric light.

The electric headlight recently introduced on an engine on the Lake Shore & Michigan Southern railroad is reported to be giving excellent satisfaction.

Recently, in Bellville, Kan., a boy, while playing in the street caught hold of the loose end of a guy wire attached to an electric light hole, and completed an unexpected circuit to the ground. Before he was released he had received a severe burn on the inside of the left arm and a bruise or burn on the left ankle

The Louisville & Nashville system, in conjunction with the Atlantic coast line intends to place in service this fall a vestibule train similar to that run in the Pennsylvania system and composed of Pullman cars, which are lighted by the incandescent electric light.

The contract for the river electric light plant has not been executed by the city of Chicago as yet for the reason that the plant will cost about $30,000, while only $15,000 has been appropriated, and the law requires that the appropriation shall cover the amount of a contract before the contract is executed. However, it is believed that the city will not be long without this plant.

A company has been formed in Paris, France, to supply compressed air to users of dynamo machines for electric lighting. This scheme is to do away with the difficulty and inconvenience attending the use of steam engines. A central station has been provided where engines of 3,000 aggregate horse power will compress the air. The mains are already being laid, and the work is being pushed on with all possible speed to furnish motive power to the theaters within the time allowed by the government order for the substitution of electric light for gas,

In a new primary battery suitable for incandescent light, the electrodes are zinc and iron, or zinc and copper, the iron or copper electrode being covered with some depolarizing materials. The exciting fluid is caustic soda. Dr. Walmsley, who has tested the battery, reports that a current of 3.45 ampères was obtained for fifty hours; after 100 hours continuous running the current was 3 21 ampères, and a further run of fifty hours brought it down to 2.27 ampères. The crucial point in the system is the process by which the inventor hopes to recover all the zinc and about ninety-five per cent. of the caustic soda consumed.

At Mobile, Ala., the entire plant of the late Brooklyn Lighting company has been removed from the Southern market buildings to the quarters of the recently formed Progress company, and will be utilized in the contract to light the city by electricity.

Tall handsome poles were erected several years ago by the Brush Electric Light company of Rochester, N. Y., on Lake avenue—one of the handsomest thoroughfares in that city, a condition precedent being that the poles should not be turned into signboards. However, some miscreant, with an eye to the value of those poles as a place for his advertisements, decorated each one with from two to four posters, and now there is a general howl of indignation from the aristocratic residents of the avenue.

The Washington authorities have decided that all electric wires must be insulated and that arc light wires must be laid under gronnd.

In the streets of Liege 500 c.p. arc lamps have been installed, the current for each being provided by a small combined dynamo and turbine placed in the pedestal of the lamp post. These lamps have only been fitted up by way of experiment, and as the system is not very economical its continuance is doubtful.

THE ELECTRIC MOTOR.

The contract has been let for the construction of an electric railway up College Hill at Eaton, Pa. The road will be about a mile long and will ascend a hill which has an 8½ feet grade for over 1,000 feet. The Daft system is to be used and the road fully equipped will cost $18,000.

In Rochester, N. Y., both the Rochester City & Brighton street railway and the Electrical Railway company desired the privilege of running cars on the boulevard—controlled by the Boulevard company—extending for five miles along the river to the summer resort at Charlotte. A cloud of injunctions appeared all at once; each company was forbidden taking steps that appeared to be prejudicial to the interests of the other companies. Recently the directors of the three companies got together, each presented a proposition for the acceptance of the others, and the prospect at present is for a union company. The electric motor will be used for power. This all the companies have agreed upon.

Three months ago the *Daily States* of New Orleans put in a seven and one-half horse power motor to supply power to a Scott web perfecting press. Recently a 15 horse power Sprague motor has been substituted for the former to keep up with the increased circulation of the paper. Fifteen thousand papers an hour are now struck off the press.

THE TELEPHONE.

The American Bell Telephone company has filed in the federal court at Indianapolis twelve infringement suits against citizens of Laporte for using Cushman instruments.

At Oakland, Ill., the Bell Telephone company has also begun infringement suits against Cushman telephone users.

The Western New York Mutual Telephone & Telegraph company has been granted permission to string its wires on poles in the streets of Rochester, N. Y.

I was riding in Ocean avenue past the lines of villas, which increase in number and beauty as the years go by, says a Long Branch correspondent. It was midday, and I caught a view of two ladies waltzing in the parlor of General Thomas T. Eckert, general manager of the Western Union. I fancied that they were casually practicing some of the frequent new styles of round dancing. But the rhythmic grace of their movements was not compatible with the seeming lack of music. I looked again and saw that one was holding the receiver of a telephone close to her own and partner's ears, and that they reversed often enough to avoid winding themselves up in the connecting wire. Later I was shown the other end of the arrangement in a telephone directly over the orchestra in the West End hotel parlor, where a daily concert is given at noon.

In Honolulu the charge for telephone rental is three dollars per month.

William Davis, of Chicago, has brought suit for $15,000 damages alleged to have been sustained by a fall from a telephone pole which he says was dilapidated, against the Chicago Telephone company.

J. J. Everingham of Parsons, Kan., has applied to the city council of that place for a franchise to establish a telephone exchange. Some years ago a telephone franchise was granted to the Parsons Telephone exchange, and an outfit of wires and instruments was put up, but during the past two years the company allowed its business to run down, and the council recently declared the franchise forfeited. Since the appearance of a new company in the field the old company has begun to look the matter up and will probably also appear before the council asking that its franchise be revived.

All the telephone wires in Guayaquil were broken during the recent upheavals of the earth throughout Ecuador.

In a recent circular letter the American Cushman Telephone company asks that defendants using its telephones, against whom the American Bell Telephone company brings infringement suits, notify the former in order that its solicitor may prepare and forward the form of answer to be made in such cases.

Forty cases have been begun by the American Bell Telephone company and the Central Union Telephone company against forty telephone users in Findlay, O. The petitions, which were filed in the United States circuit court, are printed in pamphlet form. Four or five are against Findlay corporations, such as the First National bank, the Findlay Window Glass company, the Peerless Refining company, the Columbia Glass company, and the Chamber of Commerce. The petitions set forth that these subscribers are using a telephone system which is an infringement on the Bell patent, and in support of the plaintiff's claim, the result of several important cases are cited. In order to bring the matter to a direct issue, the plaintiffs embrace in their petition a set of interrogatives which they pray the court to compel the defendants to answer on oath. The plaintiffs pray the court to decree that the defendants pay over all profits or gain accruing from the use of said telephones, and in addition to pay damages for the infringement, and they ask further that the defendants be perpetually enjoined from using said instruments, and also be enjoined from removing any infringements.

The vessel dispatching office of Chicago will hereafter be in charge of Captain John Weckler, a seaman of twenty years' experience

THE TELEGRAPH.

A marriage took place recently by telegraph from Fort Supply to Fort Sill, Indian Territory, a distance of two hundred miles. The contracting parties were Clark Smith and Miss Emsey Nason; Joseph Fox, United States commissioner, officiated, and William Garvey and H. F. Ambrose were the witnesses. Everything went lovely, and a full ceremony was given by means of lightning.

It is said that Robert Garret, John W. Mackay, D. O. Mills, Whitelaw Reid, of the New York *Tribune*, John R. Walsh, principal owner of the Chicago *Herald* and a banker of that city, and George W. Childs of the Philadelphia *Ledger*—all millionaires several times over—have completed a combination of all telegraph lines in opposition to the Western Union, including the Baltimore and Ohio, the Bankers' and Merchants', the Postal, and the Bennett-Mackay cable.

A telegraph line has been recently constructed in Madagascar, running from Tamatave to the capital, Antananarivo.

It is claimed that Chicago furnishes one-third of all the telegraph poles used in the United States, one ninth of all the railway ties, and five per cent. of the posts, supplying railroad and telegraph lines from New York state to Utah.

The octuplex system, the property of the Standard Multiplex Telegraph Co , invented by R. G. Brown, is being thoroughly tested. It is to be adopted by the Postal company, and the Bay State Telegraph company, a new company with lines between New York and Boston. It is said the English government is well pleased over the success attained by the multiplex system in that country. The government bought the patents for England.

The Commercial Union Telegraph company of Albany has increased its capital stock to $200,000, and proposes to extend its lines. Poles will be erected and wires strung from Albany to New York via Chatham, Ghent, Philmont, Nillerton and White Plains; also from Albany to New York via Hudson, Poughkeepsie, Peekskill, Tarrytown and Yonkers.

Miscellaneous Notes.

The Western Edison Electric Light company will put up a substantial building on the vacant lot next to and east of the Home Insurance building specially adapted to their use.

Red Cloud, Neb., will soon be illuminated by means of ten electric light towers.

At the Royal institution, London, Mr. Wimshurst exhibited an exceedingly interesting experiment, in which small type, placed on a disk revolving several thousand times a minute, was distinctly seen and read while in motion. This was accomplished by means of an electrical arrangement, which caused brilliant sparks to illuminate the print at the exact instant only when the type was vertical. But for the buzzing produced by the great velocity of the disk the words would have been supposed to be at rest.

Edison sends up from Llewellyn park every night a small balloon held by a wire. The balloon bears an electric light, which, at the height of 4,000 feet or so, it is impossible to distinguish from a star.

Two young electricians of Munich, named Mestern and Helidobler, have invented a sort of telephone which fixes the spoken word on a chemically prepared sheet of paper.

Miss Adeline Slaton of Augusta, Ga., was recently struck dumb by lightning. Two red spots on her left cheek show where the electricity entered. She was rendered unconscious by the shock, but revived in a few minutes, and is now in good health, but can not utter a word.

Messrs. Thorneycroft, of Chiswick, England, have completed a torpedo boat for the Spanish government which on a trial attained a speed of 26 knots an hour. The boat is propelled by twin screws, with engines and boilers for each screw, and either engine can be worked by either boiler. The boat has ten complete bulkheads, and one half bulkhead. Each compartment has a steam ejector and is lighted by electricity.

The board of directors elected by the stockholders of the United States Electric Fire Alarm company, of Evart, Mich., August 6th, consists of the following: William R. Mapes, E. C. Cannon, C. O. Trumble, C. L. Gray, and David Wolf. The board of directors met the following day and selected as officers of the company for the ensuing year: president, William R. Mapes; vice-president, E. C. Cannon; secretary, F. A. True; treasurer, David Wolf; electrician, S. A. Chase.

By a recent invention pertaining to primary and secondary batteries the electrolyte or exciting liquid is caused to penetrate the pores or cavities of the electrodes by placing the latter in a closed cell or jar, which can be hermetically sealed, and in which a vacuum is created for allowing the electrolyte to penetrate the interior of the electrodes, or pneumatic or hydraulic pressure is exerted for attaining a similar result. The electrolytic action is thus caused to permeate the whole interior of primary battery elements, and the active coating of secondary battery electrodes.

The directors of the Minneapolis exposition are considering the advisability of requesting Mr. Gladstone to open the exposition this year by pressing an electric button in London, as Mrs. Cleveland did in Washington last year. The cable companies are now investigating the feasibility of the scheme.

Visitors to the recent Leipsic fair flocked in crowds to see the so-called magic bedstead which was exhibited in a booth on the Konigsplatz. By means of a strong electric current the occupant of the bed is twice aroused through the ringing of a bell, after which a tablet with the words, "Time to get up!" is thrust before the eyes of the sleeper, then his night-cap is pulled off his head, and last of all—if not thoroughly awake by this time—he is pitched out of bed on the floor. Meanwhile the busy electric spark has lighted the night-lamp on the dressing-table, and the spirit-lamp under the coffee-pot—an admirable arrangement for the dark winter mornings.

An inventor by the name of Cass in New Britain, Conn., has brought out a new engine that is mysteriously described as remarkable; that is, that an engine of 10 horse power occupies a space of only 18 inches long by 10 inches high, can be hung on the wall like a bracket for a shaft, does the work, and at a very small cost.

The illumination of the Trocadero palace in Paris during the recent *fête nationale* required 45,500 burners, which consumed 2,895,000 cubic feet of gas during the night. The bridges and quais were illuminated, in addition to gas, with 78,800 glass lamps of various colors.

The Troy Electric Light company is having a wagon made for special service at fires. It will be provided with apparatus to cut the wires wherever they endanger the service of the firemen.

Personal Paragraphs.

H. H. Kingsbury of Sydney, New South Wales, Australia, was in Chicago a few days ago. He expected to leave San Francisco for home on the 27th ult.

J. J. Dickey has resigned his position as superintendent of telegraph of the Union Pacific railway lines to assume increased duties with the Western Union company, and L. H. Korty has been promoted to succeed him. The changes took effect August 15th.

E. M. Barton, president of the Western Electric company, has just returned from an extended trip through the northwest.

Don A. Palmer has received the appointment of electrician for the Town of Lake, with headquarters at the fire alarm office in Englewood.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	385	400
Central Union	44	45
Michigan	75	76
Great Southern	30	33
Colorado	20	22
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27

NEW ENTERPRISES.

At Kansas City. Mo., W. H. Plum will build a $7,000 residence, and will fit it with electric bells.

In the same city R. F. Kellogg will erect a residence to cost $4,000. It will also be provided with electric bells.

Chas. M. Clark, of Kansas City, is about to build a residence to cost $8,000. It will have electric appliances.

"The Chadwick," consisting of ten brick houses after plans by A. H. Ramsden, architect, will be one of the notable residence flats of Kansas City, Mo. It will cost $125,000, and will be supplied with the electric light

A residence block of eight houses is to be built at Kansas City by W. Weston. The estimated cost is $75,000. Electric bells will be used throughout.

Wimbish & Powell, of Kansas City, are about to erect a residence block of five houses. The houses will be provided with electric appliances.

F. N. Sewell will erect a handsome residence of stone, brick and marble in Kansas City at a cost of $125,000. A. H. Ramsden is the architect. Electric bells will be used.

At Independence, Mo., M. A. Dias will build a residence block of three stories, to cost $40,000. M. E. Chamberlain, of Kansas City, is the architect.

At Kansas City, Henry Smith will build a residence block of two stories to cost $27,000. Electric bells will be used.

A stock exchange is to be built at the Union Stock Yards, St. Joseph, Mo., to cost $10,000. The electric light will be put in.

At LaSalle, Ill., a new hospital is to be built at a cost of $15,000. Rev. Father Schmall is in charge of the undertaking.

W. S. Frazier, of Aurora, Ill., will build a $15,000 extension to his factory.

P. Cudahy will erect at Sioux City, Ia., a packing-house which will cost $150,000.

James & James, of Kansas City, are the architects of a residence block that will be erected by Mrs. Lockridge, of the same city, to cost $100,000. Electric bells will be put in.

E. B. Shearer, of Kansas City, Mo., will build a $5,000 residence. Electric bells will be put in.

Kansas City, Mo., is to have another new hotel to cost $150,000. C. J. Hopkins is the owner and James & James the architects. It will be lighted by the electric light and provided with electric appliances.

A $7,000 residence, provided with electric bells, is to be erected by John C. Alendorf, of Kansas City, Mo.

S. M. James, of the same city, will erect a four-story residence and business building to cost $50,000.

At Choteau Springs, Cooper county, Mo., C. B. Lakin is about to erect a hotel to cost $25,000, from plans by L. L. Levering, of Kansas City, Mo.

At New Orleans the Crescent City Brewing company have determined to invest from $50,000 to $80,000 in a brewery. The plans and specifications have not been completed.

At Albert Lea, Minn., Johnson & Nelson will erect a store to cost $11,000. It will be lighted by electricity.

BUSINESS MENTION.

The Woodbury Engine company's boiler shop at Rochester, N.Y., is full of orders for tubular boilers. Using only the best grades of stock to be purchased in America and employing only first-class workmen, this company has secured an enviable reputation on boilers. It is a fact for them to be proud of that in thirty-six years they never had a Woodbury boiler explode.

The Hutchinson Water, Light & Telephone Co., of Hutchinson, Kan., has ordered a pair of Gaskell compound condensing engines for the pump room, a 125 horse power Armington & Sims engine for the electric light plant and a smokestack 78 feet high and 63 inches in diameter.

E. I. Ballou, of the Chicago office of the Brush Electric Co., has recently closed a contract for a 90-light plant for the city of Ludington, Wis., and a six-light plant for a mill in the same place. The steam plant that will be used in connection with the dynamos that will light the city is in and the lights will be in operation in 90 days.

The Putnam Machine Co., of Fitchburg, Mass., are putting a 125 horse power engine in the Eastern Illinois Insane Asylum at Kankakee, Ill. A part of the power will be used to run the new 25-light arc dynamo contracted for of the Western Electric Co. Two new boilers 60"x16 ft. are also being put in by the Putnam Machine Co. The institution is also being provided with a complete Gamewell fire alarm system.

The Chicago Electrical Development Co., with its present office at 171 Randolph street, Chicago, has been formed for the purpose of placing inventions of merit on the market. The company has advantages that will enable it to accomplish this result speedily and with assurance of success. Inventions and patents will be bought outright or articles manufactured and sold on royalty.

The Edison Electric Illuminating company, of New York, has awarded to the Babcock & Wilcox Co. a contract for 8,700 horse power in water-tube boilers for three new central stations in that city. This makes the thirty-fifth order received from various Edison companies.

The contract for lighting the Haymarket theater on the west side in Chicago has been taken by the United States Electric Lighting company. The plant will consist of 1,500 lights, and power will be furnished by an Ide engine.

The Callender Insulating Co., of New York, have secured the contract for placing all the electric light wires underground for the Thomson-Houston Electric Light Co., of Buffalo. The Callender solid system will be put down for the greater part of the work. The conduits will be made of vulcanized wood and will contain arc, incandescent and power cables. Work will be started at once. The Thomson-Houston Co have decided to put their wires underground at once on the score of economy.

The Chicago Arc Light & Power Co. has placed an order for four miles of Patterson electric light cable with the Western Electric Co., of Chicago.

The new multiple switch board of the Chicago Telephone company, contracted for of the Western Electric Co., will have 3,000 equipment.

The Kansas Electric company, of Topeka, has secured a contract from the Santa Fe road to furnish their new hotel and eating house at Hutchinson with a fire alarm and return call system of bells. They will also put in about a thousand feet of speaking tubes. They have just finished supplying a large hotel at Clay Center.

F. W. Horne, who recently returned to Chicago from the south to become manager for the western and southern states for the Excelsior Electric company, has shown that he has lost none of his old time enterprise. This company's 60-light plant at Stillwater, Minn., that had been in successful operation for five years, was recently sold to the gas company at that place for $10,000.

Hazazer & Stanley, New York, are succeeding beyond their expectations. Mr. Stanley was formerly a resident of Chicago, and left an assured and well paying position to branch out in business, with a partner, for himself. They regularly employ from twelve to fifteen men in their shop.

The facilities of Holmes, Booth & Haydens for manufacturing painted wire have been increased three times within a year. No better proof could be adduced of the merit of the wire.

A. G. Day's kerite wire and cable factory, according to a handsome photograph sent out by Clark B. Hotchkiss, general agent, 16 Dey street, New York, is as solid and substantial as the reputation of the goods turned out of that factory.

The Jarvis Engineering company has issued an elegant lithograph showing the method of setting a tubular boiler on the Jarvis system. Under the skillful administration of H. A. Glasier, the western office at 81 Lake street, Chicago, is widely introducing this meritorious furnace throughout the west.

At the Reliance Works, E. P. Allis & Co., Milwaukee, Wis., the following engines are building: Warren Manfg. Co., Warren, R. I., one quadruple compound engine with cylinders of 24", 36", 52½", and 64½" by 72" stroke; Plymouth Cordage Co., Plymouth, Mass., one compound, cylinders 30" and 60" by 72"; Sewall & Day Cordage Co., Boston, Mass., one compound, cylinders 22" and 44" by 60"; Carnegie Bros. & Co., Edgar Thompson Steel Works, Pittsburgh, Pa., three rail mill engines 46"x 60", 46"x 60", 30"x 48"; Carnegie, Phipps & Co., Homestead, Pa., reversing plate mill engines, a pair of 30"x 54", and a pair of 40"x 54"; Sloss Iron & Steel Co., Birmingham, Ala., five blowing engines, steam, each 40"x 60", air, 84"x 60"; Ashland Iron & Steel Co., Ashland, Wis., two blowing engines 34"x 48", 78"x 48"; Belleville Nail Co., Belleville Ill., a pair of reversing engines 28"x 48"; City of Milwaukee, a six million gallon pumping engine 20"x 36", 35"x 36", 49"x 36"; Cleveland Iron Mining Co., Ishpeming, Mich., pumping engine 18"x 60"; Milwaukee County hospital, pumping engine 8"x 24"; Tamarack Mining Co., Opechee, Mich., a pair of reversing engines 16"x 36", and for their smelting works, one 22"x 48", one 28"x 60"; Kearsarge Mine, Lake Superior, an air compressor 20"x 42", 22"x 42"; Minnesota Brush Electric Co., Minneapolis, Minn., 22"x 48"; Thomson-Houston Electric Light Co., Racine, Wis., 18"x 42"; Menominee Mining Co., Iron Mountain, Mich., 14"x 36"; Warren Springer, Chicago, Ill., 32"x 60"; Grand Avenue Cable R. R., Kansas City, Mo., pair 32"x 48"; Albion Mill Co., Mendocino, Cal., 28" x 48"; Capital Gas Co., Sacramento, Cal., 20"x 48"; Davidson & Sons, Milwaukee, Wis., 20"x 48"; Radbourn Bros. & Hixson, 24"x 48"; Gorham & Sargent, Cleveland, O., 20"x 42"; Dennis Long & Co., Louisville, Ky., 18"x 42"; A. Cutler & Son, Buffalo, N. Y., 18"x 42"; Industrial Works, Bay City, Mich., 16"x 42"; Farmers' Protective association, Fort Collins, Colo., 16"x 42"; Chicago, Rock Island & Pacific Ry., one 16"x 36", one 14"x 42"; L. Banks Holt, Graham, N. C., 18"x 48"; C. W. Seefield, St. Charles, Minn., 14"x 42"; J. F. Glidden, DeKalb, Ill., 12"x 36"; C. A. Murdock & Co., Kansas City, Mo., 12"x 30".

Where all the telegraph pins and brackets come from is a question answered in part at least by the Central Electric company of Chicago, who have a factory at Columbia City, Ind., capable of turning out 12,000 pins and 5,000 brackets per day. On the other hand, where all these pins and brackets go is very satisfactorily answered by the order book of the company, showing demands that keep the mill full of work. The mill is in the heart of a white oak section, and therefore the cost of the raw material is less than it would be if the mill were located at a distance from the source of supply.

The combination of electric lighting and gas is working very successfully at Saratoga Springs. About six months ago, the Saratoga Gas company and the Electric Lighting company there, using the American system of electric lighting, were combined under one organization. The electric light plant consisted of 125 arc lights and about 300 incandescent lamps. The electric light has become so popular in Saratoga that the company is now increasing its arc light plant. An addition of fifty lights has just been ordered from the American company. It has been suggested to the company that the lighting of the avenue, from the Grand Union hotel to the race course, as well as the race course itself, so that, during the hot weather, racing could be held in the evening instead of day-time, would be a very great attraction. Whether this will be done this season or not is yet undecided, but it is being very carefully considered. If the trotting association should decide to use electric lights, it would be one of the greatest attractions, as well as one of the greatest novelties, in Saratoga.

Arrangements have been made to erect an Edison central lighting station at Jerseyville, Ills. A number of public spirited citizens have organized the Jerseyville Electric Light Gas and Power Co. It is expected that operations will be begun by the middle of September. The complete contract for steam plant has been placed with the Pond Engineering Co. of St. Louis. It consists of an 75 horse power Armington & Sims engine, 80 horse power steel boiler, 120 h. p. Lowe heater, boiler feed pump and injector; also foundations, brick and pipe work, the whole set up ready for service. This plant is to be a model one in every way.

The *Globe Democrat*, St. Louis, has ordered from the Pond Engineering Co., a sixty horse-power Armington & Sims engine. They have been using a smaller engine of the same make for some years past, in connection with their Edison plant which has recently been enlarged.

The Callender solid system of underground incandescent cables has been adopted by the new Edison Co., in Grand Rapids, Mich., and the Callender company are making about fifteen miles of large cables for feeders for this company. The Columbus Edison Co. are laying all their wires underground and the feeders are being laid by the same company upon their solid system. The cables for the new Edison Co. in Washington are to be laid underground. The Callender Co. has secured the contract. Some of the cables have an area of nearly half an inch of copper.

The C. B. & Q. railroad company are equipping some of their suburban service cars with electric light. The first will be ready in a few weeks. In one respect the arrangement will be novel. Instead of being suspended from the ceiling, the lamps will be attached to fixtures fastened to the sides of the car over the backs of the seats, giving a reader of a newspaper, for instance, an abundance of light just where he needs it. Johnson, Holland & Co. will furnish the electrical equipment, including storage batteries.

The National Machinery Co., of Denver, Colo., is quite active in the electric lighting business. A new electric light company is being organized in Denver to use the American system of electric lighting. Fifty lights have just been ordered, and it is expected that this will be added to considerably within the next few weeks. The electric lighting in Denver, up to the present time, has been done by the Brush and Edison systems. It is now likely that the American will gain a strong foothold there as the principal man in the management of the Brush Co. has resigned his position to connect himself with the American system.

The Boston Electric Light company, under the management of President F. A. Gilbert, has become the largest local electric light company in the United States. The plant was composed of the consolidation of the Brush Electric Light company of Boston, the Merchants' Electric Light company of Boston using the Thomson-Houston system, and the New England Weston, the combination of the three plants making about 1600 arc lights. The company has recently acquired the Citizens' Electric Light company of East Boston, with a capacity of about 2500 lights, which were built and owned by the American Electric Manufacturing company of New York.

Electrical Patents.

Issued August 23d, 1887.

368,576. Conduit for Electric Railways. Frederic Euphart, Boston, Mass.

368,596. Electrical Resistance. Walter H. Knight, New York, N. Y.

368,608. Secondary Battery or Accumulator. Antoine E. Peyrusson, Limoges, France. The electrolytic liquid contains sulphate of tin in solution. The positive electrode consists of a lead rod with radiating strips and a bottom plate.

368,628. Telephone. Herbert L. Todd, Washington, D. C. The diaphragm forming one electrode is centrally supported, leaving its edges free to vibrate. The resistance varying electrodes are suspended from above on a rod so as to bear lightly by gravity against an edge of the diaphragm from the rear. Included in the circuit is a multiple coil which forms the magnet when in use, the corresponding ends of the coils being connected, and in one direction, leading to the battery, and in the other to the diaphragm electrodes, and thence to line.

368,650. Stop-Cock for Electro Pneumatic Brake Systems. J. Fairfield Carpenter, Berlin, Germany.

368,654. Electric Hose-Coupling. Edward H. Crosby, Boston, Mass.

368,674. Electrical Apparatus for Voiding Water Pipes. James W. Kent and Robert Orr, Brooklyn, N. Y.

368,689. Controlling Device for Clocks. William S. Scales, Somerville, Mass. A movable centering device is controlled by an electro-magnet, and coöperates with the sleeve which carries the second-hand of the clock, moving said sleeve independent of the motion imparted to it by the motor, so as to set the second-hand in any determinate position. The sleeve, at the same time, serves to change the vibrational length of the pendulum.

368,692. Printing Telegraph. Robert J. Sheehy, New York, N. Y. An armature supported upon a universal joint and rocking or vibrating in four different directions is employed. A circular movement of an armature lever or arm fixed to the armature is thus occasioned and this rotary movement is conveyed to the type-wheel shaft through a train of gear connected with the armature lever through a crank-arm. The four single-coil electro-magnets of the armature are successively placed in circuit by the action of a circuit controller. Two line wires are employed, capable of being alternately connected through one of the electro-magnets, and that diagonally opposite, while the other is connected alternately through the remaining two electro-magnets.

368,745. Process of Tanning by Electricity. Johann Wilhelm Aborn and John Laudin, Stockholm, Sweden.

368,764. Connecting Device for Electrical Conductors William J. Hammer, Boston, Mass.

368,765. Safety Catch for Electrical Circuits. William J. Hammer, Boston, Mass. The safety strips are formed of fusible wires braided, woven or twisted together.

368,766. Support for Electric Conductors. Maurice J. Hart, New Orleans, La.

368,796. Portable electric propeller for Boats. Gustave Trouvé, Paris, France. The invention is covered by five claims. The first and third are as follows:

"1. The combination of a removable propeller and a removable electric motor, whereby said propeller is operated, with a boat which is driven by the operation of said motor and propeller, substantially as set forth.

"3. A removable attachment to the stern of a vessel in combination with a motor, and a propeller shaft supported by said attachment and removable therewith, substantially as set forth."

368,804. Electrical Resistance Coil. Chauncey D. Baker, Chicago, Ill.

368,806. Electrical Battery. Thomas W. Bryant, Ansonia, Conn.

368,809. Combined Electric Receiving and Transmitting Device. Franklin S. Carter, Burlington, N. J. Signals may be sent and received back and forth between two stations on the same circuit. The claims are limited to constructive details.

368,857. Electric Safety Lamp for Use in Mines. Miles Settle, Snow Hill, England. The incandescent lamp is carried on a float placed in an air-tight vessel. The escape of the fluid from the vessel breaks the electric connection and extinguishes the lamp. An automatic locking bolt is employed to prevent accidental closing of the electrical connection when once broken.

368,858. Printing Telegraph. Robert J. Sheehy, New York, N. Y.

368,859. Printing Telegraph. Robert J. Sheehy, New York, N. Y. The type are carried on flexible arms of different lengths and pass in their revolution above a printing roller. The shaft carrying the arms may be arrested in any desired position with the required type above the roller. An impression hammer is then thrust against the arm carrying the type and an impression of that particular type is made on the paper

368,907. Fire Alarm Telegraphic Repeater. Charles Burgher, Boston, Mass.

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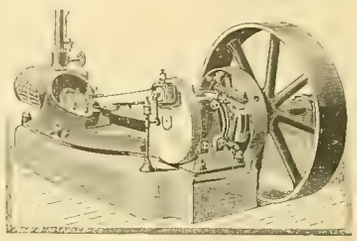

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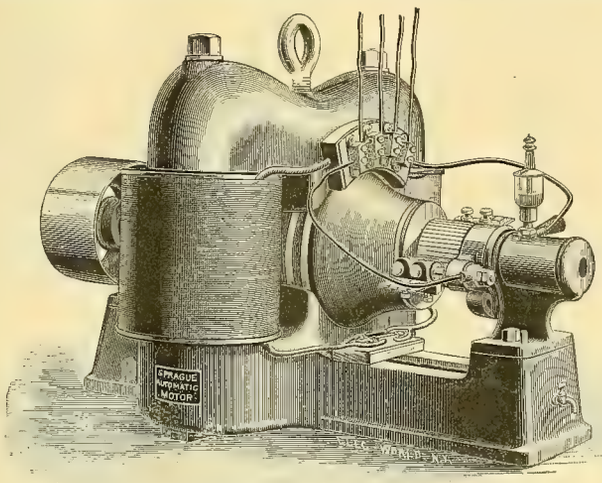

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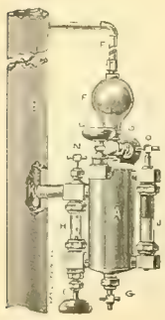

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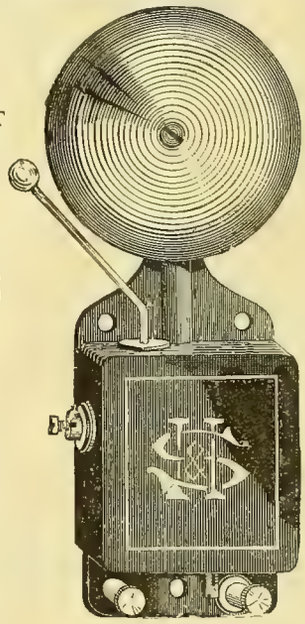

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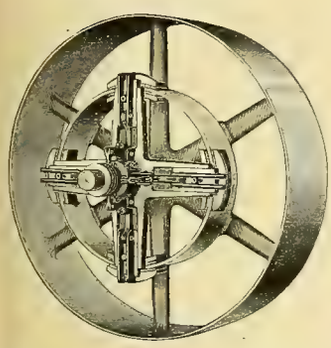

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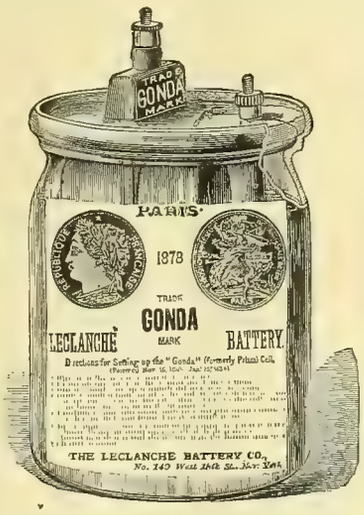

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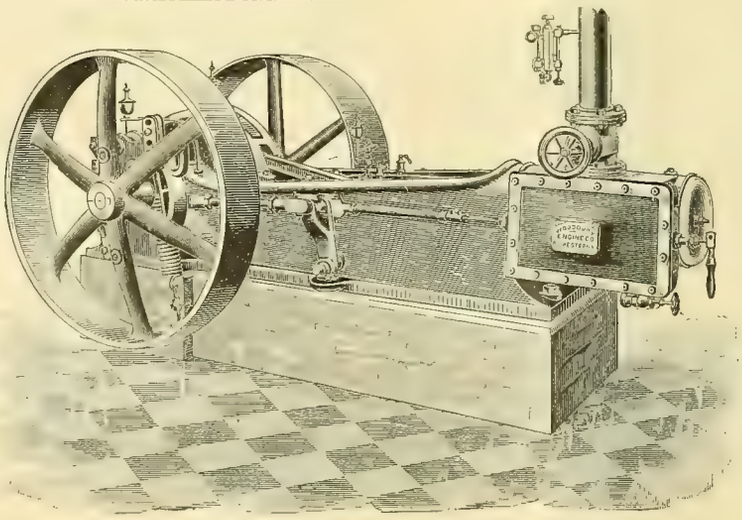

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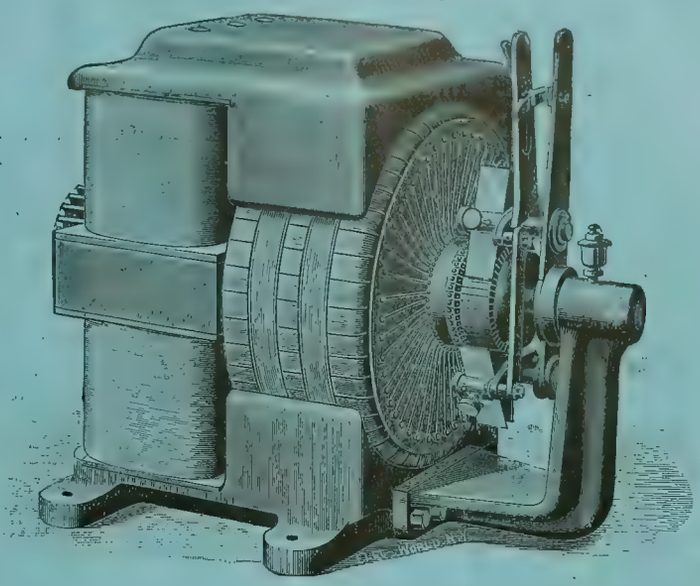

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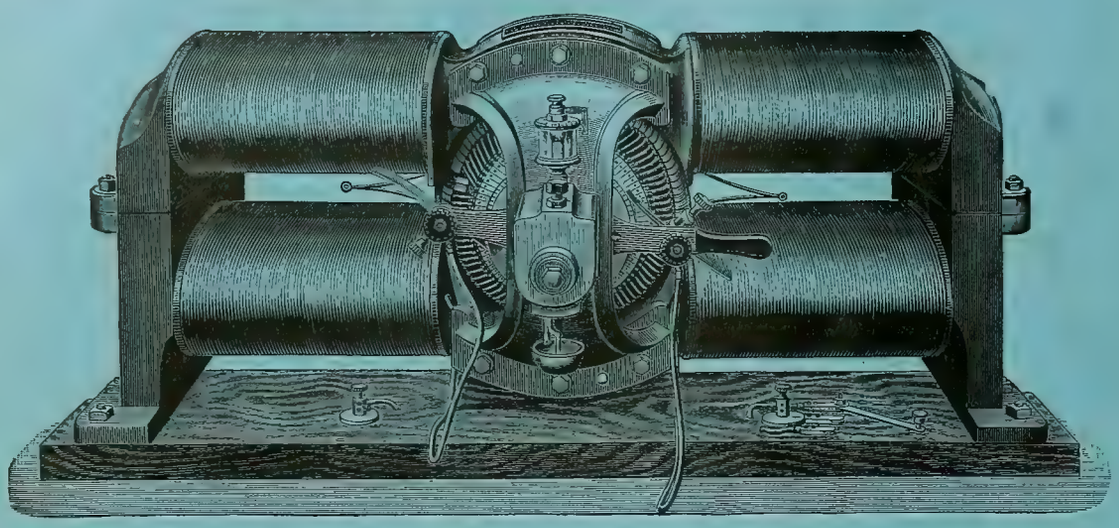

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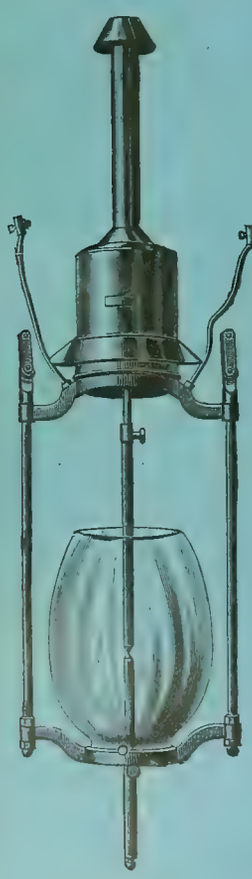

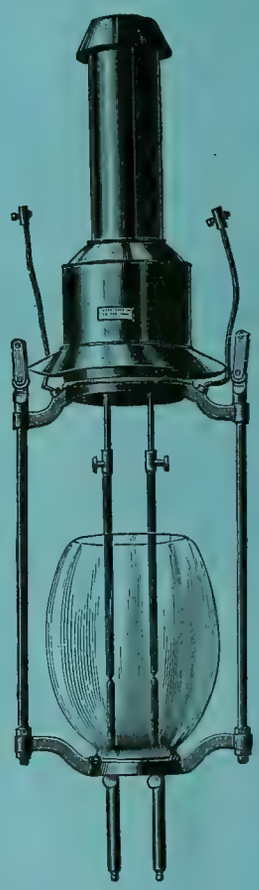

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Vol. I. CHICAGO, SEPTEMBER 10, 1887. No. 11.

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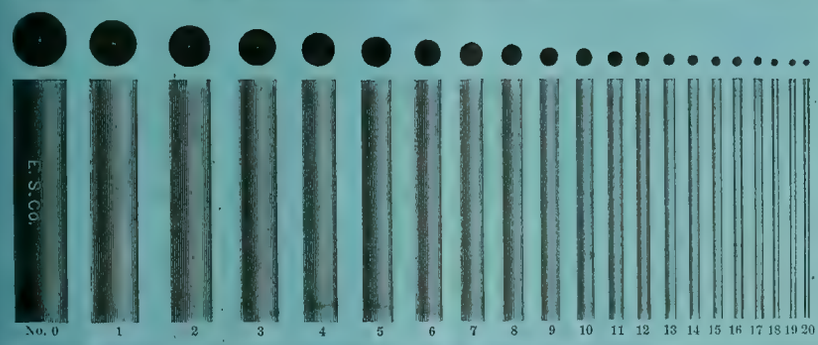

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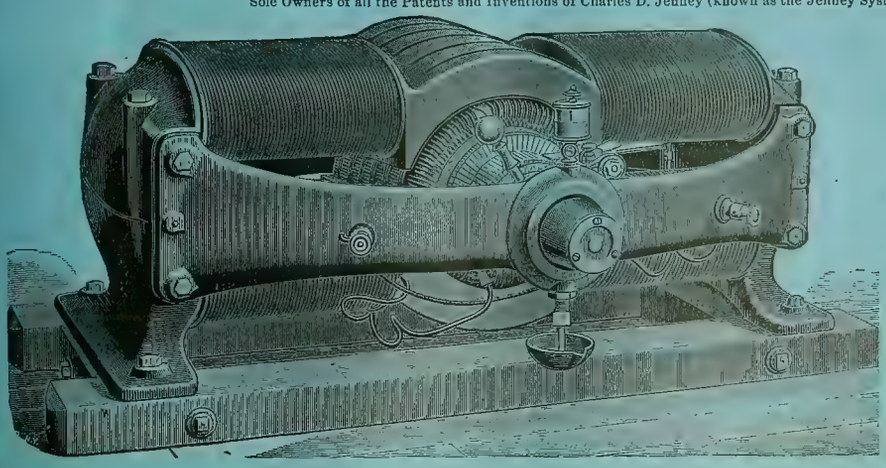

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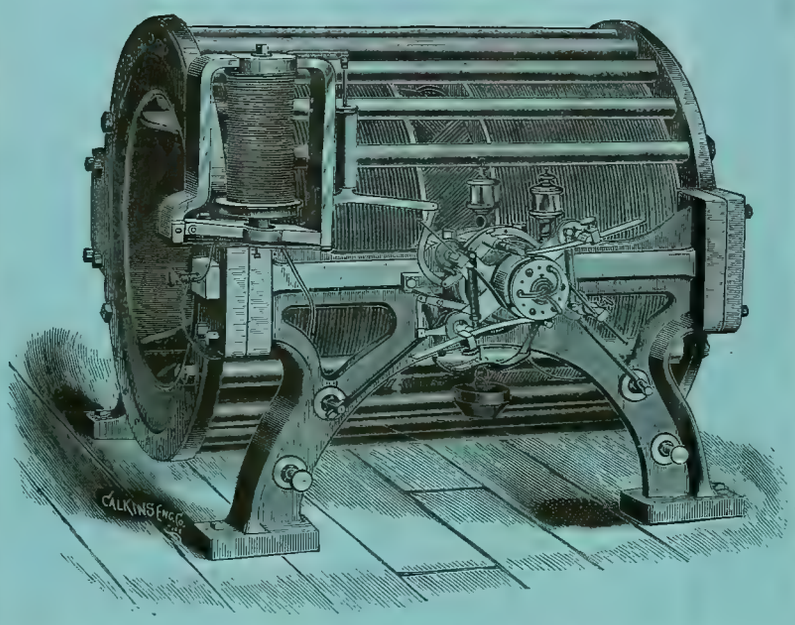

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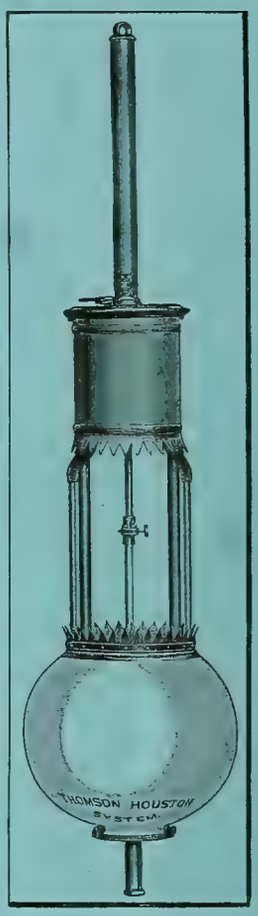

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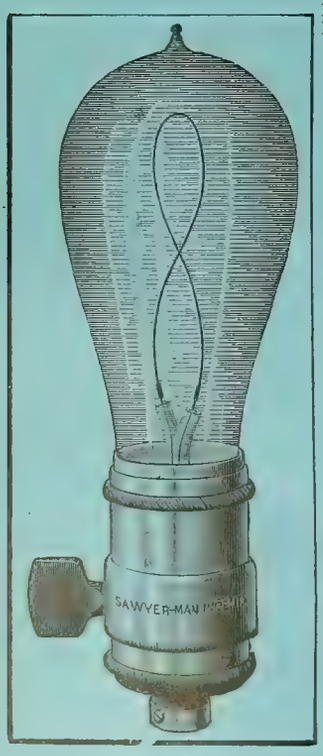

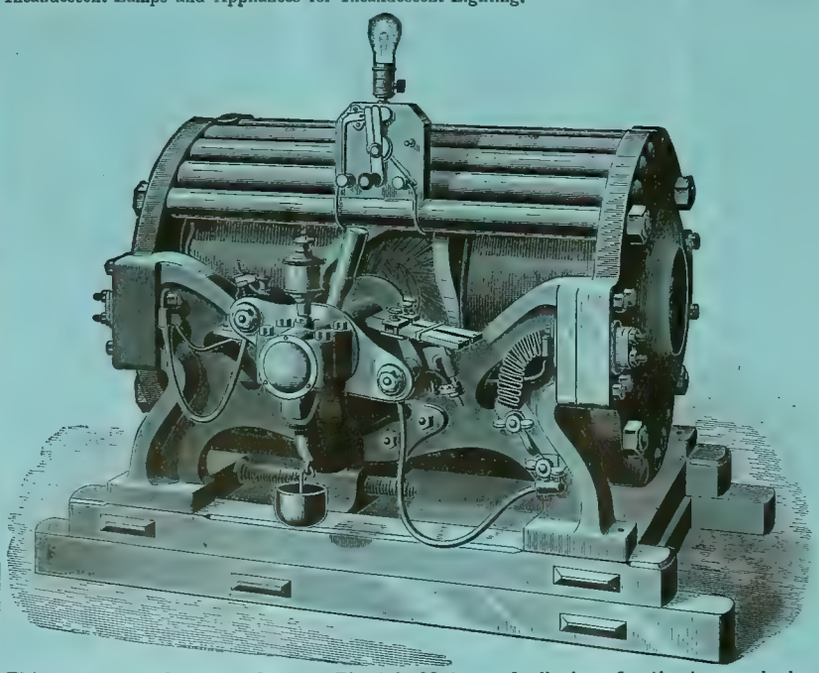

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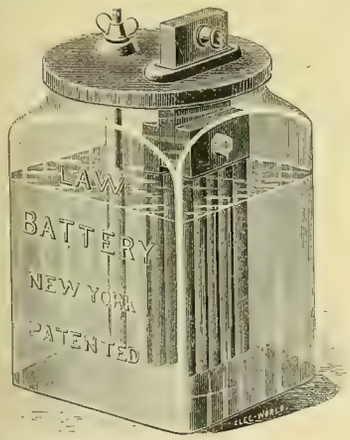

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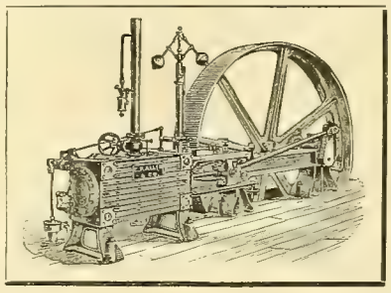

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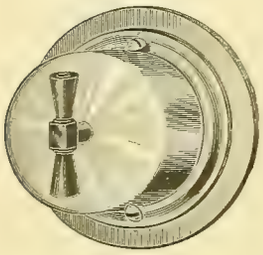

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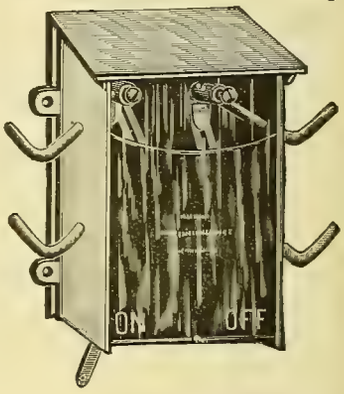

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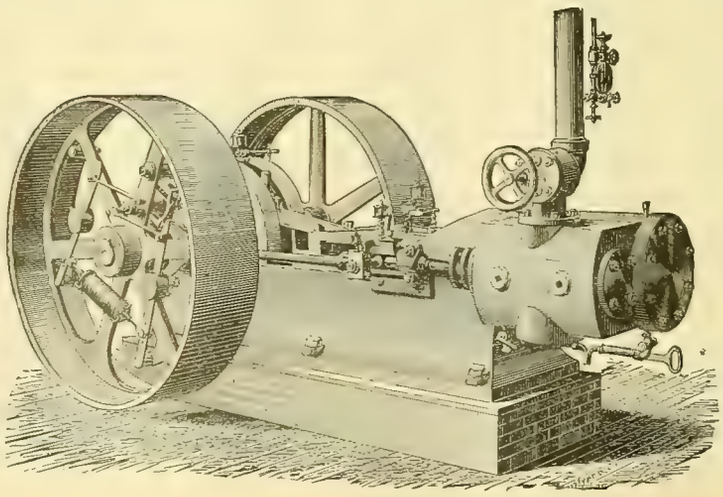

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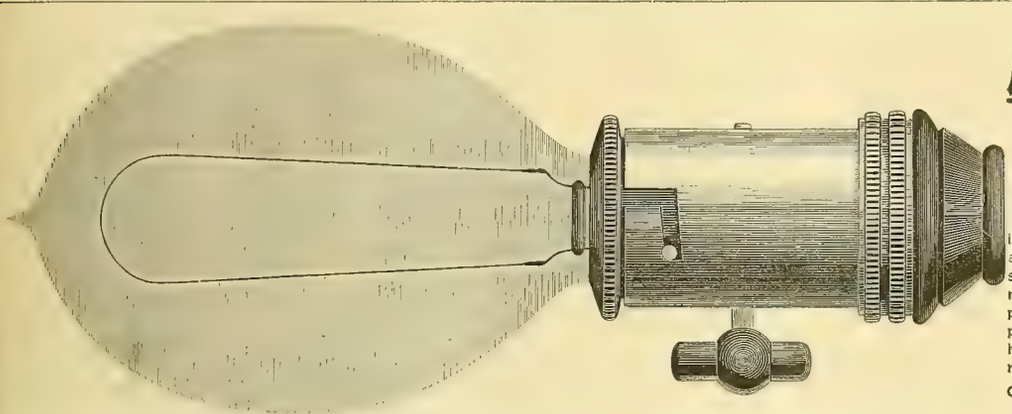

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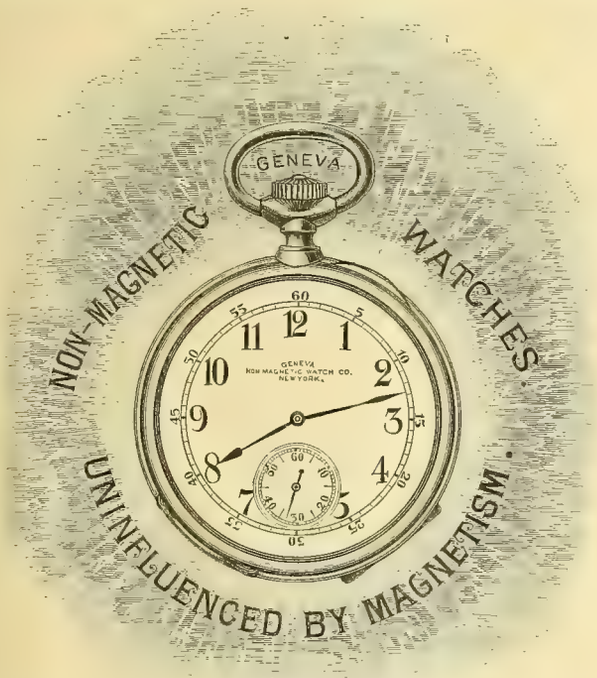

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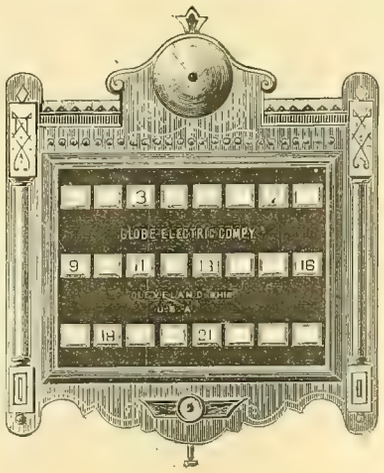

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4	Indicators	$12 00	40	Indicators	$ 71 00
6	"	16 00	50	"	92 00
8	"	20 00	60	"	106 00
10	"	24 00	70	"	121 00
12	"	29 00	80	"	132 00
15	"	36 00	90	"	145 00
20	"	44 00	100	"	155 00
30	"	57 00			

With Alarm $3.00 Extra, Subject—

THE GLOBE ELECTRIC COMPANY,
CLEVELAND, OHIO, U. S. A.

Patterson Weather-Proof Electric Light Wire,

The best Fire and Weather-Proof Electric Light Wire in the Market.

The price is not greatly in excess of that for the ordinary UNDERWRITERS' ELECTRIC LIGHT WIRE.
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Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE STILLMAN.
CLEVELAND, O.

Cleveland O. May 25th 1887

C. C. Warren, Mgr
Us Electric Lighting Co., Chicago.

Dear Sir— It always gives us pleasure to communicate the working of our electric light plant, which has been in operation since Oct. 1st 1885. For more than a year not a cubic foot of gas has been burned in the Stillman. We have the electric lights in every room, and can depend upon them absolutely. There has rarely been a stoppage, and never a serious interruption of the current, although the machinery is in continuous operation night and day.

The light undoubtedly costs less than gas; but were such not the case the avoidance of smoke and heat, and the saving of oxygen would make make it preferable.

Very truly yours,
The Stillman Co.
by H. Pelle, Mng. Dir.

ST. GEORGE HOTEL
THE PRIVATE OFFICE OF
D. J. Mackey & E. P. Huston.

Evansville, Ind. May 5 1887

Mr. C. C. Warren, Mgr
The United States Electric Lighting Co.
Dear Sir.

We started the Electric Light Plant you placed in our hotel April 2nd 1886, and have run the same continuously ever since, with no gas. Our hotel being entirely and perfectly lighted by your system, we have had but little trouble and have always been able to adjust any thing that got out of order ourselves.

We believe your light the acme of perfection and after more than a year's trial can say that we are perfectly satisfied and think the St. George Hotel is one of the lightest hotels in the West.

We are very respectfully
D. J. Mackey & E. P. Huston

The United States Electric Lighting Co.

Address: **C. C. WARREN, Manager Western Department 216 La Salle St., Chicago.**

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, SEPTEMBER 10, 1887. No. 11.

An Arc Light Adjustable Hanger.

On this page we show an illustration of a new adjustable hanger made by the Western Electric company for use in connection with arc lights. This hanger does away with unsightly counterweights which have been largely used for the purpose of raising or lowering lamps and as well does away with the use of step-ladders for reaching a lamp. The hanger is so arranged that the lamp can never fall, and at the same time the lamp can be readily raised or lowered to any point. There are no springs to weaken and get out of adjustment. These hangers are extensively used in the plant put in the wholesale store of Marshall Field & Co., Chicago.

Peculiarities of Electric Currents.[1]

By C. C. Haskins.

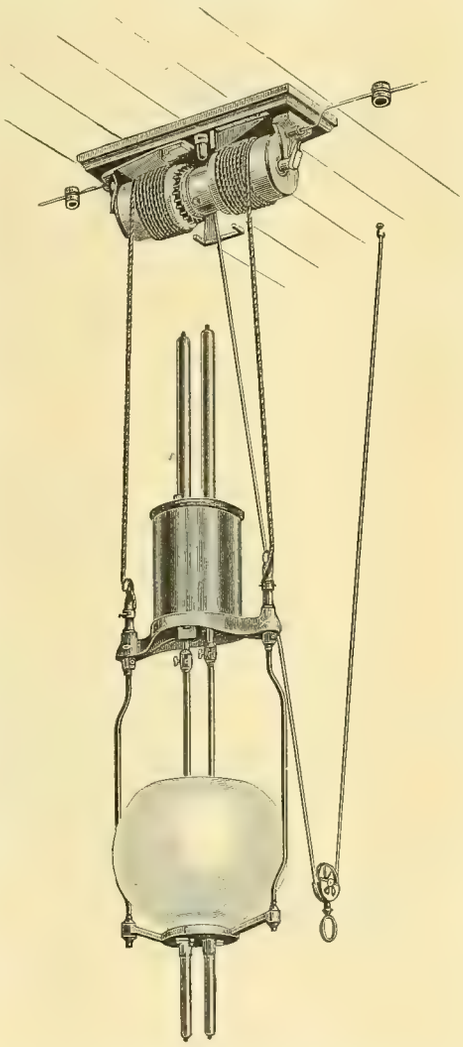
At the last meeting of the club we were all well entertained and instructed in the matter of physiological effects of electrical currents. Owing to the lateness of the hour that paper was not given the attention in the way of discussion which it richly deserved, and I ask, the privilege of presenting some matters which are closely connected with Professor Badt's paper.

That gentleman following Dr. Stone, stated that the average resistance of the human system would be about 936 ohms, and the doctor also stated that a current of 100 to 200 volts might, under certain circumstances, prove fatal, as in a case of well soaked cuticle, and especially if this moisture contained some chemical salt in solution—a salt of soda, potash, etc. The degree of dryness and thickness of the skin at the point of contact would have much to do with the effect.

Professor Ayrton states that the intermittence of currents also constitutes an important factor, and adds that it is probable that continuous currents are less dangerous than the irregular currents of some forms of machines.

A case is mentioned where a horse, browsing near one of the conductors of a railway using a current at 250 volts pressure, touched the metal with his moist nose and was killed, while children and others were playing with the conductor, taking shocks, without inconvenience.

The other day at Boston, at the electric light convention, some statements were made which I must confess staggered me. Let me read from the proceedings: "As regards the danger of shocks, I have had a little experience on both sides. I have had a full share of the arc light shock. I have opened circuit on 1,500 volts, which was sufficient for me. I have also taken 1,000 volts alternating, and there is no comparison between the shocks at all. If I may be allowed to give my own experience, I should say that the Thomson-Houston machine gives about the most tremendous blow I have ever felt. It is a peculiar dead stroke which you do not find in the Brush. But the alternating machine seems to throw you off instantly, you do not have time to take hold. We had a case in Philadelphia the other day which I think will be something for Mr. DeCamp to hear, as I believed he feared it was one of his men. We had been changing one of these buildings from direct to alternating, and while the building was still on the direct current one of our wire men went into the cellar and put an ordinary key socket onto the mains to give him light After the building had been turned into alternating currents, one of these wires which had been used originally became a dead wire, and the lamp having been taken out of the socket there was nothing to show that current was passing through the wire. One of our men went down stairs to make some changes, and our foreman cautioned him particularly to look out for those alternating current wires, as one of them was grounded. Two of the men went down together, and one of them forgetting that the building had been changed to alternating, went feeling around to get hold of this socket. He found it, and he laid down on the wet ground, and the other man stumbled over him, and spoke to him but received no answer. He



spoke to him again, and stooped and looked at him, and finding that he was getting black in the face ran off to call for help. He ran down to the station, and while there learned that the foreman had gone to another building, and he ran after him. The foreman told me that the moment he heard something was wrong there he knew what it was. He ran down in the cellar, and he found this man lying on his back perfectly still and blue in the face. He stooped down and shook him and got a terrific shock himself. He saw that he still had hold of the socket, and he took his coat, so that he would not get the shock himself, and pulled the wire out of the man's hand, and then they picked him up. He had been then on the current, as near as we could estimate, four minutes, taking the full benefit of a thousand-volt current. The men did not know what to do, but fortunately they treated him for asphyxia. The man was blue in the face. They cut his clothes open and dashed water on him, and tried artificial respiration, and in the meantime sent for an ambulance. By the time the ambulance got there he was sitting up, and refused to get into the ambulance, and seemed to be very much disgusted that an old arc light man like himself should be keeled over in that way by an alternating current of only 1,000 volts. The next day he expressed himself as perfectly well and ready to go to work. We had some difficulty in getting him to go and see the doctor, but we insisted on it, as we were more afraid of the nervous shock than anything else. The doctor told us that he was simply badly burned. The structure of the skin had been destroyed, as is usual in all electrical burns, and the burn had extended some distance, following two or three inches under the skin, and that the real danger was in the burn. He said if it was opened up the whole length he would recover with very little trouble. The man told us that for two minutes at least of the time he was on the wire he was perfectly conscious, that he knew his companion was there and he tried to tell him to pull the wire away, but he could not speak, and that when the man went away he knew perfectly well it was for assistance, and he then realized that it would be three or four minutes before they could get back, and he thought to himself that he could not stand it that length of time, and then forgot everything. He said that he felt no particular pain. He got a shock that he would get from any electric current, when he first laid hold of it, but after that he felt nothing. The sensation seemed to be like that of drowning. As soon as we got him to gasp and breathe, his color came back again. This incident has given me quite a new hold on the alternating current system—to know that you can take 1,000 volts of it and stay on it that length of time. I know I should be very sorry to take a direct current one-quarter of that time."

Now this statement is mighty good reading, coming as it does from a race of people who live and flourish on natural gas around the junction of the Allegheny and Monongahela rivers; but somehow, while there didn't seem to be any very lively discussion, but rather a tacit submission to the statement, I can hardly feel satisfied that we have all the particulars in the case. Everyone whom I have ever had the pleasure of listening to on the matter of shocks seemed to have forgotten some part of the story. He leaves out the other wire that belongs to the derived circuit system of which the victim was a part, or some other equally prominent factor.

One pointer, however did crawl out from under the extinguisher before it finally shut out all the light. Somebody said that where converters are left out of doors, and air spaces are left for ventilation in the covers, moisture will get in, and ground will develop on the high tension wires. Now to counteract any troubles that may arise, the expedient of grounding one side of the secondary or incandescent circuit is proposed. In my experience, this animal called "ground" is a breeder. In either arc or glow lamp circuits, I have become convinced that the constant ground is a positive detriment to the general insulation of any line. I look upon it as a relic—a rusty, gray-haired electrical fossil, and to adopt this method of protection, which is only effective through the danger it inaugurates, is to work backward and call it progress. I have

1 Read before the Chicago Electric Club, September 5th.

said that the ground is capable of reproduction. I think no gentleman present will dispute this proposition.

Let there be half a dozen minute leaks on a line above ground, and neither of these is sufficient to develop a positive ground. On another portion of the same line let there be a positive ground, and this latter will, if favorably situated, develop heat in uncomfortable quantities. The situation is one in which the division or derivation of the circuit radiates in practice from the underground point and reaches out like the fingers of an outspread hand to half a dozen or more slight leaks. I think the placing of permanent grounds upon a line is fraught with mischief, and I very much incline to the belief that better insulation is a far superior protection to permanent grounds, even through high resistances.

It was not my intention to go very deeply into this matter, but I find on conversing with one or two of the club members that this matter of induced, of secondary, of alternate currents is very little understood, and I have endeavored to get a few pieces of hastily arranged apparatus together to show these differences.

We will first consider a primary, direct current battery. It is composed of two elements, the positive, zinc and the negative, black oxide of manganese and carbon. The current, as generally considered, flows from the positive element to the negative, through the solution of sal-ammoniac, and from the positive pole to the negative through the outside wire. There is no magnet in the circuit, and this constant flow may with impunity be received through the tongue. We will place a magnet in the circuit, and we find a marked difference in the effects. This difference is entirely due to the discharge which has been called the extra current-discharge. It is a form of induction, and is proportioned to the number of ampère turns of wire and the amount of iron in the core. In the circuit with the battery we will place an interrupter. The interrupter merely opens and closes the circuit. At every change of this nature, opening and closing, we get a spark and a shock. The extra-current is discharged many times in a minute. The original force is only the current we had from our six jars. There is no secondary coil here.

Now we will change the arrangement and place an automatic breaker in the main circuit, while in the secondary current we will place ourselves. This is an induced current. You feel nothing while the current is closed through the main, but when the circuit is opened there is a result, and also at the moment of closing

Now let me put the reversing magnets in circuit. We will then get alternate currents. The quantity of current here, between terminals, is about $\frac{3}{100}$ ampère. These are the currents which our friend spoke of, and these are the effects of alternate induction from only six Leclanchè cells, about nine volts. Make this electro-motive force 100 times greater than this, bring it up to 1,000 volts, what would the result be to anyone who was testing it physically?

Here is a magneto generator. It is a peculiar instrument, manufactured by the Western Electric company here, and kindly loaned for the occasion. Its peculiarity consists in its having a switch, by means of which I can, at will, have either a straightened or direct current, or I can make it deliver an alternate current. What I want to do is to show, if possible, the different effects of the two currents—the direct and the alternate.

Another experiment, which originated with the Count du Moncel, gives us a hint how to produce a constant current of an undulatory character by means of a magnet, a coil and a galvanometer. The effect is feeble, of course, because rude and quite weak apparatus is used. The effect may, however, be seen in the movements of the needle, which remains on the same side of zero, but shows less or more influence according to the position of the magnet relative to the coil.

Recent delicate scientific experiments have discovered the fact that the surface of the land is never absolutely at rest for more than thirty hours at a time. Thus, those great earthquakes which make epochs in history are merely extreme cases of forces that seldom sleep.

An Electric Street Railway.

Fig. 1 of the views shown in connection represents an electric street railway car of the Van Depoele Electric Manfg. Co., at Binghamton, N. Y., and Fig. 2 at Lima, O. Both of these plants are of recent date and are giving excellent satisfaction in regard to service and to economy of operation. The plant at Binghamton, N. Y., consists of one 100 horse-power generator, three 15 horse-power motors, and three 10 horse-power motors, and is owned by the Washington Street and State Asylum Electric railway, S. M. Nash, lessee; H. Wilcox, superintendent. Mr. Nash writes under date of the 1st inst.:

"I leased the Washington Street railway last spring. It was run by horse power and had been losing money every year. I have equipped the road with an electrical plant of the Van Depoele system, and commenced running by electricity May 25th last. The road has paid largely since the start, and our receipts are increasing every day. We have no trouble whatever with the electrical apparatus. We run four cars all the while and six on extra occasions. I have been renting power but shall equip a station with my own steam plant in the spring. Every one is pleased with the electric road, and real estate has advanced at least twenty-five per cent. along the line in consequence of the use of electric power on the road."

The plant at Lima, O., consists of one 60 horse-power generator, five 10 horse power motors and one 15 horse power motor. It is owned by the Lima Street Railway Motor & Power Co.; B. C. Faurot, president; F. L. Sangan, secretary, and J. H. Rose, superintendent. The cars were run for public use on the Fourth of July for the first time. Twenty-five thousand strangers were in town that day and the cars were in use for nineteen hours to accommodate those who wished to experience the novelty of riding for the first time on a car propelled by electricity. Crude petroleum is used for fuel, and the president of the company states that the cost for power is less than one dollar per day per car, for a run of seventeen hours.

Fig. 1.—Van Depoele Electric Street Car at Binghamton, N. Y.

That Telephone Concession in China.

Count Eugene de Mitkiewicz, accompanied by a Chinese imperial envoy and suite, passed through Chicago last week on their way to Washington, bearing letters from the viceroy to Secretary Bayard. A summary, by translation into English, of these letters reads as follows:

"On opening, the viceroy states his desire to bind China and the United States in closer bonds of friendship, and he has therefore granted to Count Mitkiewicz and Wharton Barker of Philadelphia the following concessions: A national and international bank is to be formed under an imperial charter giving sole and exclusive rights as regards the Chinese imperial and provincial governments. This bank is to be supplied by America and China with a capital of 50,000,000 taels, in proportions to be fixed hereafter, but the larger to be American. It will establish itself in Chinese commercial centers and have branches in all foreign cities with which China has any interests. It will have the right to coin money, receive and disburse imperial and provincial treasury funds, carry on the finances of those governments and will act, in fact, in a large sense on the credit-mobilier system. It will advance funds, construct railways, telegraphs, canals, river improvements and systems of drainage and take part in building forts, arsenals and public works. The syndicate will also take all existing telegraph lines and have exclusive right for fifty years to manipulate telephones."

The active agent in the enterprise, Count Mitkiewicz, is a man of varied fortunes. He appeared first in Rochester, N. Y., as an exiled Russian nobleman, several years ago and married there the daughter of a wealthy man. After bearing him seven children his wife died and the count soon left the city. Subsequently he ran a summer resort near Washington and was a prominent frequenter of the lobbies of the hotels of the capital. Two years ago he married Miss Yates, a descendant of Justice Marshall. The count is a man of fine address and a fluent speaker of several languages.

The First Theater Electrically Lighted.

A private discussion as to the first theater in the United States to be lighted by the incandescent electric light has brought out some interesting correspondence. The Western Edison tric Light Co. think that the Academy of Music, Chicago, was the first theater to put in a plant of the kind described, and fixes 1882 as the year. The month and day are not so definitely fixed, but it is approximately given as about the middle of September of that year.

Edward H. Johnson, president of the Edison Electric Light Co., of New York, thinks the Bijou theater of Boston, Mass., was the first. He states that the plant was an isolated one put in for the use of the theater only, that the theater was fully lighted throughout, no other light being employed, and that the plant was installed in fourteen days from the date of receipt of order.

James McElroy, at present electrician of the Hollis street theater in Boston, writes: "The exact date when the incandescent light was first put in operation in the Bijou theater, Boston, was Tuesday, December 5th, and the first time before the public, December 11th, 1882. The theater was dedicated Monday, December 11th, 1882, by Collier's Standard Opera company in Gilbert & Sullivan's 'Iolanthe.' I claim to be the first man that used the incandescent light for stage and theater."

So far the Academy of Music, Chicago, seems to be ahead with the odds decidedly in favor of the Edison light.

Chicago's gas bill last year was $600,000. No wonder there is a demand for the electric light.

The National Fire Loss.

The national fire loss, considered in the aggregate, brings to attention some startling figures. The aggregate loss during 1886 was a round $105,000,000, the largest annual loss on record except in 1884, when it reached $110,000,000, and except, of course, the years of the Chicago and Boston fires. But the current year bids fair to look at its close upon the largest annual ash-heap that was ever seen. The average monthly loss thus far in 1887 has been over $10,000,000, the total figures being $76,928,100, making a seven months' loss larger than the entire annual loss of any year previous to 1881, excepting 1879, and that year it was less than $1,000,000 more.

The distribution of fires varies so widely from year to year that no "experienee tables" can possibly be made. For some years the middle and western states suffered about 32 per cent. each of the total loss; the New England states 13 per cent.; the southern states 15 per cent. and the Pacific states and territories about 7 per cent. But last year the eastern and middle states decreased the percentage of loss, and the western, southern, and Pacific states increased theirs. This year, again, things are reversed, and the east is suffering heavily. The losses in New York city last year were comparatively light; but more property has been destroyed in the first seven months of this year than in the whole of 1886. No cause can be assigned for these fluctuations, and in view of the varied experience of many years it is very much to be doubted if there is one.

During the year 1886 there were 15,222 fires. The origin of 1,913 is unknown, and the origin of 5,651 if known was not reported; of the 7,698 remaining fires, 1,959, or 26 per cent. of those whose origin is known, was attributed to incendiarism. The other 5,739 were attributable to 58 different known causes. Of all the known causes, then, the incendiary is responsible for the most fires. In 1886 he destroyed $11,597,324 worth of property, or a trifle over 10 per cent. of the total loss. But this is his usual percentage according to the figures.

Next to incendiarism the defective flue is the known cause of the largest number of fires, 1,004 fires resulting from this cause in 1886, which is about 13 per cent. of those whose origin is known, and of 7,300 fires in dwelling-houses during the last three years, the origin of which is known, the defective flue heads the list of 36 principal causes, and caused about 20 per cent. of them all. Forest and prairie fires come third, and matches fourth. This is a striking commentary on the manner in which dwellings are built. During 1886 there were 102 fires in New York state known to result from defective flues, 94 in Ohio, 93 in Indiana, 92 in Pennsylvania, 90 in Illinois, 71 in Massachusetts, 65 in Missouri, 46 in California, 37 in Texas, 30 in Maine, 29 in Georgia, 22 in Kentucky, and so on. From these figures it may be assumed that the careless building of dwelling-houses is not confined to any one section of the country. The ten principal known causes for all fires in the country are: Incendiarism, defective flues, sparks (general), matches, lightning, lamp explosions, stoves, spontaneous combustion, lamp accidents (not explosions), and locomotive sparks.

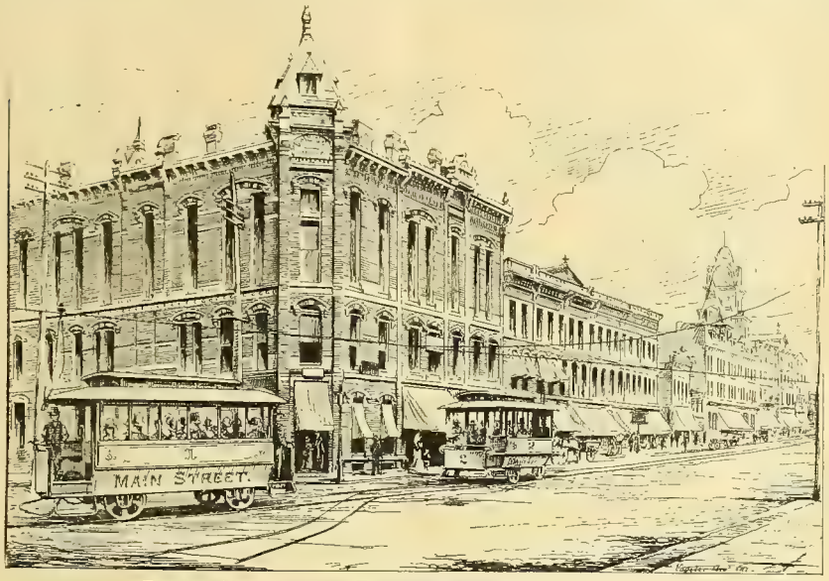


Fig. 2.—Van Depoele Electric Street Car at Lima, O.

Selenium.

At a recent meeting of the Swedish Royal Academy of Sciences, Prof. E. Edlund, the celebrated Swedish electrical savant, read a paper on the effect of the sun's rays on selenium, describing the most recent experiments made with that substance on this point, particularly in Sweden, of which which the following is an excerpt: Some twelve years ago it was announced to this society that the metal selenium, discovered by Prof. Berzelius, had a greater electrical conductivity when exposed to the rays of the sun in a dark chamber. This applies to the crystalline form of selenium, whereas in the amorphous state it is a bad conductor of electricity. This remarkable peculiarity of selenium has since many times been the subject of research in several countries, and particularly among Swedish savants, the results of which are that it has been discovered that the effect of the light varies under different kinds of light, and that it is, moreover, so powerful that the electrical resistance under favorable conditions, in bright sunshine, is not more than 6 or 7 per cent of the magnitude when the metal is in a dark chamber. During the last few years these researches have been resumed by electrical savants, who have succeeded in demonstrating some other important electrical peculiarities possessed by this metal.

The selenium is melted on a metal disk, with which it can form some chemical combinations, and is distributed in a layer, the thickness of which is only two or three-hundredths of a millimeter. On this layer of selenium a gold leaf is pressed, so thin in texture that the sun's rays can penetrate it and reach the layer of selenium. Now, if this composition be exposed to the influence of the sun's rays, and its electrical resistence be tested by leading an electrical current from the gold leaf to the metal disk below, it will be found that sometimes the conductivity will decrease to ⅓ per cent. of what it is when the element is placed in the dark. By this method the sensitiveness of selenium to the light has been found to be twenty times greater than was formerly known to be the case. Moreover, it has been demonstrated by these researches that the resistance of the selenium depends upon the direction of the electrical current, the resistance being fifteen to twenty times greater if the current runs from the gold leaf to the metal disk than vice versa. This phenomenon, which was demonstrated in a dark chamber, seems to indicate that the chief obstacle to the continuity of the current must be sought in the point of transmission between the gold leaf and the selenium layer, or between that of the latter and the metal disk, as any difference in the resistance offered by the selenium itself, whether the current runs in one or the other direction, is impossible. This view is also supported by the circumstances that the resistance was dependent upon the strength of the current as well as upon the electro-motive force of the battery.

Another discovery, also of interest and importance, was made. If the gold leaf and the metal disk, between which the selenium layer is placed, were connected by means of a wire attached to to a galvanometer, it showed that the electric current began to circulate as soon as the gold leaf came under the influence of the sun's rays. We may ask whether the light at the points of contact between the selenium layer and the metals with which the latter is surrounded effects some chemical change, whereby the formation of a current is caused, or whether the active force possessed by the light is immediately transformed into an electric current? As the current commences at the moment the element is subjected to the light and ceases the moment the latter is removed, the last-mentioned solution seems really the most natural. This being as it may, we have by these experiments obtained a dry pile, a pile without acids, which may lead to the discovery of other secrets.

A Human Electric Generator.

Anton Saverne, a Belgian cabinet-maker, employed at a Kensington shipyard, has the wonderful power of producing electric sparks by rubbing his fingers.

"I know not how I do it," he said last evening, as the reporter saw sparks shoot from Saverne's fingers. The cabinet-maker rubbed his finger-tips rapidly up and down upon his trousers; then, holding his hands out with his fingers widely extended, jets of tiny yellow flames, or long sparks, shot out. They seemed propelled by some unseen force ten or twelve inches into the air, when they vanished. The right hand seemed more charged with electricity —if the sparks are electric—than the left. The lamp in Saverne's front room was put out, so that the sparks might be seen in all their brilliancy. It was a wonderful sight. Again and again did the bushy-headed Belgian rub his fingers and hold them out, while showers of bright sparks darted out as if from toy fireworks.

"I was not always so," said Saverne. "When I had been sick ten years ago it was said I would die. I lay so weak one night in my father's house when there came up a storm. Such thunder and lightning I never knew before. And my body had such queer sensations. While I lay, covered up with bed-clothes, my mother sat holding her face in her hands by my side, and I seemed to feel a thousand needles pricking my limbs and chest and the soles of my feet. It was not so painful, for queer thrills came with every prick, and when the thunder rolled away and the rain stopped I rose up, leaned back, and put out my hand to take that of my mother's. My eyes were closed, but I heard her cry 'Anton!'

"'What!' I gasped weakly.

"'Your hand.'

"I looked at it. The one nearest to her. It was all aflame. I was terrified. My cry brought my father and sister to the room. They looked at me in horror. I took my other hand from the clothes to rub the right. Sparks shot from the fingers of the left. Soon they died away, but I have but to rub my hands as you have seen and the lights come."—*Philadelphia News.*

Chicago Electric Club.

The Chicago Electric Club met last Monday evening, Professor F. B. Badt acted as chairman. Routine business of minor importance was transacted, and the club then listened to a paper presented by Mr. C. C. Haskins, printed in full in this issue. The different experiments outlined in the paper were carried out with the aid of the apparatus described, to the great interest and instruction of the members, and the physical effects of the several currents discussed.

The next meeting of the club will be held Monday evening, September 19th, at 8 o'clock.

A Street Car run by Storage Battery.

NEW YORK, Sept. 5.—A week ago Friday night, a little party composed of F. J. Weis, a train dispatcher in the employ of the Pennsylvania R. R. Co., Wm. Ettinger, electrician of the Pennsylvania R. R., A. Jackson of the Electrical Accumulator Co., of New York, G. B. Caldwell, president Citizens Ry. Co., Wheeling, W. Va., C. J. McConaughy, train dispatcher, Pennsylvania, R. R., E. V. Cavell, of the WESTERN ELECTRICIAN, of Chicago, Messrs. S. J. Sullivan, T. Bradley and others, witnessed a test of a new motor and mechanical arrangement designed by by Mr. Weis for street railway cars. The Jersey City and Bergen Horse R. R. Co., had one of its cars equipped with the device and placed its tracks at the disposal of the party. The motor weighed 400 pounds and was of five horse power size. The current was furnished by a Julien storage battery which consisted of a total of forty cells each of which weighed thirty-five pounds. The motor was placed under the car and the battery under the seats. The weight of the car and its equipment was a trifle over 6,000 pounds.

A start was made, and the inertia overcome with ease. The run was continued at speeds varying from six to twenty miles per hour, up grades of over four per cent. and around several short curves of a mean radius of about 27 feet. The switch was turned to 32 cells at starting, but quickly changed to 22, which proved ample to propel the car at a speed equal or in excess of that attempted by any cable line yet in operation.

Occasionally some one would ring the bell, and the car was stopped without jerk or jar within about its own length. Quick stops were also made on both grades and curves, and in no case was there any apparent difficulty. It is a noteworthy fact that although the battery consisted of 40 cells, at no time—even when running at from fifteen to twenty miles per hour—was it found necessary to call over 32 into requisition—not even in starting midway up a grade of from four to five per cent.

A pleasing feature was the ease with which the car was controlled, the application of the motive power by means of the friction wheels direct upon the driving wheels producing the motion, being such that neither jar nor jerk was perceptible, either when starting or stopping or when increasing the speed by switching on power from another ten cells. In pleasing contrast to the usual "buzzing" or "whirring" noise often objected to in the operation of various electric systems, was the perfect quiet with which the driving arrangement worked—not a sound being heard but that occasioned by the car running over the rails.

Those who witnessed the trial, while admitting that there is always room for improvement, returned to the Astor House at 5 a.m., convinced that, in his invention, Mr. Weis had done much to make electric traction by means of storage batteries a practical success, at least so far as satisfactory speed, easy manipulation, and economical service are concerned. C.

Long Distance Telegraphy.

"Are you interested in long distance telegraphy?" asked Senior-clerk Allen, "when he showed me through the deparment recently," writes Ralph D. Blumenfeld to *Electric Age*. Replying in the affirmative, I followed him to a desk in a distant corner, where he began to call "Ms, Ms, Ms," signing "Ts," the London office call. Shortly after "Ms" answered.

"That is Marseilles," said Allen. "I am going to have him give us Bona on the northern coast of Africa." Jerking away at his monstrous key he clicked out to Marseilles: "Please give me Bona, quick."

"All right," replied "Ms." "Call him."

Bona was "raised" and was asked to put Alexandria on. "Call him," said Bona. Alexandria was reached without much difficulty, although the wire seemed to give an occasional swing or lurch, caused presumably by some defective pole.

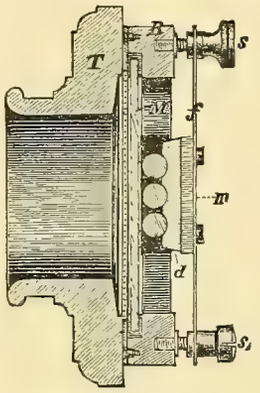
"To 'Ad.'—Can you give me Aden? Ts."

"I think so," said Alexandria. "Wire been in trouble and been raining much. Can't get these lazy Arabs to go out after wire trouble. Try "De."

"De, de, de" clicked the ponderous instrument. Here Alexandria broke in, telling "Ts" to adjust his instrument for Aden. Allen adjusted and Aden answers, "I. I. De."

Here we had a port in the Suez canal thousands of miles away, and it took but a moment for him to reply to our question, that it was very hot. Could he give us Bombay? Of course. "Please call "Bm."

It took just one minute for Aden to make his connections and for Bombay to answer us with a cheery "Good morning" that sounded as clear as a bell. He said it was hot—so hot that he had an idea he would shrivel up if it continued much longer. When told that I was an American, who understood telegraphy, and that I represented the *Globe*, he said: "Glad to see you. I once lived in Boston. *Globe's* a great paper."



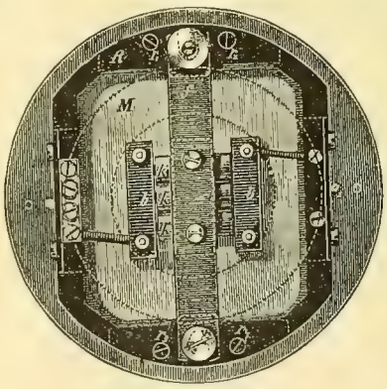
VERTICAL SECTION.

After a few more courtesies had been exchanged, the wire "busted" somewhere in France and I left the building.

And yet they say this is an unprogressive age!

The Mix and Genest Microphone.

The illustrations shown on this page give a very good idea of the Mix and Genest microphone, which is coming into use in some of the German government telephone stations established in connection with the telegraph service. As will be noted the diaphragm is vertical, and the carbon cylinders are prevented from revolving by a kind of brake. Between a cast iron ring R and the mouth piece T is inserted a diaphragm M, consisting of pine wood, and held by



FRONT ELEVATION.

the clamps a a^1, upon this diaphragm are fastened two carbon holders b b, which serve as journals for the three carbon cylinders k. Across the face of the diaphragm is placed a spring f provided with a gun metal piece m, to which is attached a layer of some soft material, preferably felt, such as is used for coating the hammers of a piano-forte. This layer of felt acts as a brake, and the pressure can be increased by tightening the screws s s^1. The resistance of this transmitter is about 4.5 ohms. The primary coil contains 250 turns of 20 mils wire having a resistance of one ohm, while the secondary coil contains 2,900 turns of 5 mils wire having a resistance of 200 ohms. Herr Grawinkel, one of the officers in the administration of the German telegraphs, states that speech by means of this microphone is transmitted very clearly and sharply to a distance of 120 miles over an ordinary iron telegraph wire, and to a distance of 15 miles through an underground cable.

Electrical Distribution by Alternating Currents and Transformers.

PART I.

In the current issue of the *Journal of the Franklin Institute*, C. H. discusses systems of electrical distribution by alternating currents and transformers, basing his paper on the series of articles by Rankin Kennedy printed in the London *Electrical Review*, March 18th to April 22nd, 1887, and reprinted in this country. We reproduce the paper.

In a brief history of such systems, obtained apparently wholly from the record of English patents, he cites, as the earliest record, a patent to Jablochkoff, in 1877, for using induction coils with alternating or intermittent currents for distributing lamps. The transformers were placed in series, and were apparently used for obtaining a higher from a lower potential, as in the ordinary Ruhmkorff coil. The next in order are the patents to Harrison, 3,470, of 1878, Bright, 4,219, of 1878, and Edwards and Normandy, 4,611, of 1878, the latter of which he says is important, as it is a clear and distinct description of a complete system. The coils are, in all of these, placed in series, and no mention seems to be made of converting high into low tension, other than a statement in Bright's patent that "the size and length of the primary wire and the secondary wire coils are adapted to the number of lights employed." The next patent, No. 5,183, of 1878, to J. B. Fuller, of New York, seems to be the first to mention a regulating device by varying "the magnetic field." The next is that of De Meritens, 5,257, of 1878, which makes no advance on prior inventions. No other patents are mentioned prior to 1882, to Gaulard & Gibbs, which, he says, has "all the elements arranged precisely as in the systems patented or described by Jablochkoff, Edwards and Normandy, Bright and De Meritens." In another patent to Gaulard & Gibbs, 1884, he says that an attempt is made to prove that the transformers connected in series are self-regulating. The writer then states that in June, 1883, he, for the first time, described the actual effects of counter E. M. F., and stated that when the transformers are connected in parallel they became beautifully self-regulating. After he made this statement, Messrs. Zipernowski and Déri, of Buda Pesth, applied for a patent (No. 3,379, March 16, 1885,) for placing the transformers in parallel. He considers this to have been a great step in the history of such systems, and claims that "no self-regulating transformer has been invented up till this date, which will give constant E. M. F. in the secondary circuit, with constant current in the primary circuit;" that is, when connected in series. He states the law that "as the current in the secondary circuit increases, the counter E. M. F. of the primary decreases, and, therefore, the current in the primary circuit increases," which law, he says, renders them perfectly adaptable to connection in parallel order to a supply at constant E. M. F. He states that the law is similar in every respect to that for motors in a continuous current circuit.

The next patent is that of Ferranti, No. 15,251, of December, 1885, the claims of which he gives in full, "to show what can be put into a British patent." It contains transformers in parallel and other accessory devices. The next is that of Siemens and Halske, No. 16,038, of 1885. The United States Gaulard & Gibbs patent is dated October 26, 1886.

In the patent of Edwards and Normandy, as well as in that of Ferranti, it was proposed to employ a converter for raising the potential of the (low potential) dynamo current, and from this converter to supply the other converters in the system. Such a system was constructed by the writer (Kennedy), in 1886, with an alleged loss of less than two per cent. in the first transformers, in which the dynamo potential of fifty volts was raised to 2,000.

In his history of such transformers, the writer does not offer any records of the invention of one of the chief and essential parts of such transformers, that of reversing the function of the well-known induction coils, and thereby converting a high tension into a low tension current of great quantity. He states at the end of his article, merely that "there is an impression

abroad" (by which he undoubtedly refers to the United States) "that the mere employment of the fine wire as primary and the thick as secondary in an induction coil was a great invention made only recently, I am certain that this has been tried by innumerable experimenters during the past thirty years." It is to be regretted that he did not furnish some proof of at least one of the "innumerable" cases. In the absence of such proof, it may be of interest to quote here, from the *Journal of the Franklin Institute*, May, 1887, p. 357, in which Prof. Elihu Thomson, in referring to some lectures which he had delivered at the institute ten years ago, says: "After showing the induction coil as so used, I reversed the process and passed high potential discharges from a charged battery of leyden jars, through the fine wire coils of the induction coil, and received currents of low potential but of great volume from the coarse wire of the coil. By putting a low resistance galvanometer in the circuit of the coarse wire, known ordinarily as the primary, a strong deflection of the index of the galvanometer took place, and upon bringing the ends of the coarse wire coil together in slight contact, a bright green flash took place at every leyden jar discharge through the fine wire."

It may also be of interest, in this connection, that Alexander Bernstein, of Boston, applied for a United States patent in January, 1883, for such a system, but it was rejected, on the ground that "it is not apparent how applicant in any case can get more quantity from a secondary coil than he has in his primary," by which, we presume, quantity of current is meant, as distinguished from quantity of energy.

In the history of the transformers themselves, Kennedy begins with the form invented by Faraday, in 1835, which consists of an iron-ring core, the two halves of which are wound, respectively, with the two wires, resembling, therefore, a Gramme ring without commutator, and having its endless winding cut at two points, thus forming two separate coils. This form is a very good one, as the closed magnetic circuit of the lines of force is composed entirely of iron; although much older than the simple magnet form used in the Ruhmkorff coil (1842) or in the Gaulard & Gibbs system, it is much better than the latter, as they have open iron magnetic circuits, instead of having the whole magnetic circuit of iron.

He goes on to describe the "evolution" of the modern transformer from that of Faraday by the inventions of Kennedy, 1883; Ferranti, 1885; Stanley, 1886; Dick and Kennedy, 1886; and Zipernowski and Déri, 1885; the best and "most novel" development being in the latter, which is the "highest class of transformer, reducing the magnetic resistance to a very small value." This invention consists in forming the two conductors into what might be termed a core of ring form and then overwinding them with iron wire; in fact, it is the transformer of Faraday turned inside out—instead of the conductors enclosing the iron, the iron encloses the conductors. Such transformers exhibit no external (wasted) magnetism, and, therefore, represent the greatest economy of magnetism.

In this history of the "evolution" of the transformer, the writer appears to neglect dates, as the alleged improvements of Ferranti, Stanley and Dick and Kennedy appear to have been invented after the Zipernowski and Déri, and were, therefore, steps in a backward direction. Furthermore, the writer does not seem to be aware of the fact that in the English patent of Staite, No. 12,212, of 1848, an induction coil precisely like that of Zipernowski and Déri is distinctly shown, described and illustrated, the only unessential difference, considering it as an inductor merely, is that it contained only one coil instead of two, the object of it being to increase the self-induction of that one coil. The placing of the iron around the ring-form conductor is, therefore, older perhaps than some of the later inventors of inferior devices.

Kennedy's later form called a subdivided transformer, appears to be a novel and ingenious improvement of the Zipernowski and Déri or Staite sheathed coil, as any or all of the subdivided coils are accessible and may be removed or cut out in case of damage without unwinding all the iron wire covering.

(*To be continued.*)

The Theory of Telephone Conductors.

BY DR. V. WIETLISBACH IN ELEKTROTECHNISCHE RUNDSCHAU.

PART I.

In number 2 of the *Elektrotechnische Rundschau* of the year 1887, I published a treatise on telephone cables. In it I applied the cable theories developed by Thomson[1], Kirchhoff[2], Vaschy[3] and others to telephone cables, and my deductions made possible a simple determination of the cable lengths permissible in actual use. The conclusions arrived at have been much disputed. It is believed that they do not harmonize with actual experience, and false results have been derived from applying them to circuits in which the theoretical requirements of the formula were not fulfilled.

Reference was made especially to the experiments which Preece has recently published, in which he made use of much greater lengths than my formulas permit. Mr. Preece determines the permissible length l (in English miles) of a telephone line by the equation $A = c\,w\,l^2$ in which c denotes the capacity and w the resistance of the length; l and a have the following values:

For copper cables	12,000
For copper ærial lines	15,000
For iron ærial lines	10,000

It is very unfortunate that this formula includes the empirical co-efficient A, which has exceedingly various values in different circuits. For, if we assume that the law of capacity is correct, then we cannot comprehend why copper cables and copper ærial lines should require different co-efficients, even if we should admit for our circuits a considerable correction on account of magnetization. If we accept the formulas set up by Preece in his experiments as proved, we can nevertheless only conclude from them that the length of the circuit can be determined by $A = k\,w\,l^2$ in which k is a co-efficient which depends on the material character of the circuit, and whose value is not given by Mr. Preece.

I notice that the recent statements of Mr. Preece do not agree entirely with his previous experience. In a paper in the *Journal of the Society of Tel. Eng.* and *Elekt. Vol. IV., 1886*, page 281, he reports experiments made by himself, according to which intelligible speech was absolutely impossible over a number 8 B. W. G. iron wire, 200 miles in length. This gives us $k\,w\,l = .012 \cdot 12 \cdot 200^2 = 5200$, while according to his new publication, good articulation is said to be possible through twice this length.

Of course, the length of conductor through which telephone articulation is possible is a very relative conception. In my treatise, mentioned above, I have laid especial stress upon the fact that intelligible speech is made impossible, not by the weakening of the tone waves, but by the change of their relative intensity. My idea of good telephonic transmission is that every single word should be intelligible by itself. In experimenting on cables or long aerial lines, we find that by increasing the length of the line at first an occasional word and finally most of the words reaching the hearer are unintelligible, but that in spite of this, entire sentences can be understood quite easily, especially if two persons who are acquainted with each other are in communication. Of course the meaning of the separate words is rather guessed than understood, and this talent for guessing cannot be taken into consideration as a technical foundation for telephoning over long distances. For this reason it is very desirable that in future experiments we should be distinctly told whether separate words were understood or entire sentences guessed. Even if we hold ourselves down to the understanding of separate words, we shall be driven to making guesses often enough in consequence of incidental defects in the apparatus and circuits, and other circumstances. As in all branches of industry, so in the matter of telephony, we desire to have a system so constructed that it will work properly, even if all conditions are not the best possible.

Every telephone apparatus consists of three parts: The transmitter, the circuit and the receiver. We know very well that all of these three parts mutually influence one another, but we will understand this mutual influence only when we are perfectly cognizant of the working of the separate parts. In the following we shall devote ourselves exclusively to the circuit. A consideration of the coöperation of the various parts is deferred for another time.

We define electric currents by four different properties: Resistance, insulation, capacity and self-induction. To develop a general theory of transmission with an adequate consideration of all these four factors would be met by very great difficulties. We will simplify the problem as much as possible, and, as we shall see later on, we are justified in this course as the practical application of our results suffers no harm by thus doing.

To begin with, we can, by carefully running the circuit, make the insulation so great that it need be considered either not at all or only as a factor for correction. Then we can divide circuits into those in which capacity is very large, self induction very small, and into those in which, conversely, self-induction is very great and capacity very small. For instance, for the former we can take anti-induction telephone cables, for the latter an iron aerial line.

A.—TELEPHONE CIRCUITS WITH LARGE CAPACITY.

For a cable, that is for a circuit with very large capacity and very small self-induction, the intensity of the current which arrives at the end of the cable may be represented by the following formula if we pay no attention to the current source. (Compare *Elektrotechnische Rundschau*, 1887, p. 14):

$$\text{I. } i = \frac{A}{W} \frac{\sqrt{2} \cdot k}{\sqrt{[e^k + e^{-k} - 2 \cos k]}} \cos(2\pi n + \delta),$$

$$\text{where } k = \sqrt{2\pi n C W} \text{ and } \operatorname{tn} \delta = \frac{e^k + e^{-k}}{e^k - e^{-k}} \operatorname{tn} k,$$

if at the beginning of the current the electromotive force is A cos. nt. When entering the cable the strength of the current is

$$i_0 = \frac{A\sqrt{[e^{2k} + e^{-2k} - 2 \cos 2\,k]}}{W\sqrt{2} \cdot [e^k + e^{-k} - 2 \cos k]} \cos(2\pi n + \delta_0)$$

If the capacity of the cable were zero, then

$$J = \frac{A}{W} \cos 2\pi n.$$

In such a circuit, the relative intensity of the separate partial tones would not be changed, and the tone color of the speaking voice would be completely preserved over any desirable distance. Intelligible speech would be limited only by this, that beyond a certain distance the strength of the current would become too weak to agitate the telephone diaphragm.

$$\text{The factor } \frac{\sqrt{2} \cdot k}{\sqrt{e^k + e^{k} - 2 \cos k}}$$

represents the influence of the capacity of the cable. For a discussion of this I would refer to number 2 of the journal mentioned above.[4]

(*To be continued.*)

Prevention of Theater Fires.

M. Larochette has devised and fitted up at the Théâtre des Nations, belonging to the city of Paris, an apparatus by which the iron curtain dividing the stage from the auditorium can be quickly lowered in case of fire. The apparatus is controlled by an electric circuit laid through the building, and provided with push buttons at various easily accessible places. Upon pushing any of these buttons a current is sent through an electro-magnetic catch, which releases and sets in motion the mechanical apparatus by which the curtain is lowered. The bolts of the panic doors are fitted with similar electro-magnetic catches, and the same current which sends the curtain down causes the bolts to fall and the panic doors to open. To make this system perfectly automatic, thermostats are inserted at frequent intervals in the circuit, so that, even should nobody think of pressing any of the push buttons, the heat of the fire itself will cause the apparatus to act. This system was tried a few days ago with perfect success.

1. Phil. Mag. T. XI., p. 146, 1856.
2. Monatsbericht d. Akad. d. Wiss. Zu. Berlin, Okt., 1887.
3. Annales Telegr. T. XI., p. 185, 1884.

4. I make use of this opportunity to correct several typographical errors which slipped into that article. Self-evidently (on page 14) one ohm equals 10^9 (cm. gr. sec), one microfarad equals 10^{-15} (cm, gr, sec). On page 15 we have as abscissa not CWn, but $\sqrt{CWn}$.

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WE present in this issue another of Dr. Wietlisbach's able papers on the theory of telephone conductors. Dr. Wietlisbach's former article, and the reply by W. R. Patterson, published in earlier numbers of the WESTERN ELECTRICIAN, have attracted widespread attention, and the series as a whole make up the most remarkable papers on this subject published in America. We shall present in the near future other articles by experts in the same line.

A VERACIOUS writer to a French periodical in describing an invention of M. Henri Paget designed for putting a person to death by means of an electrical whip, says that the Americans are a nation of wife-beaters, and concludes with: "The invention will probably have much success in the United States, where the number of husbands who beat their wives is very considerable." All of which reads very much like a *Figaro* joke instead of what was intended to be a part of a scientific description of a new electrical appliance.

September 1st the Commercial Cable company issued a notice that on and after September 15th the tariff to Great Britain, Ireland and France would be twelve cents a word, and to Germany fifteen cents a word. Conjectures, opinions, surmises, deductions, inferences and statements that have filled the columns of the daily papers in regard to the time of the settlement of the cable war are again set at naught. There was a conference a short time ago of the various cable companies, and the outcome was only a continuation of the haggling over rates. What steps the other companies will take in view of this action of the Commercial company have not yet been announced.

WITHIN a little over a week the financial world has received several successive surprises in regard to the Baltimore & Ohio system. The first was the sale of the express business to the United States Express company, and quick on the heels of that announcement came the news of a preliminary contract entered into with a syndicate which will have control of the great railroad system. It is yet too early to make a definite announcement of the disposition of the telegraph and sleepingcar business of the road, but the indications are that the Western Union will at least control the telegraph business, and the Pullman Palace Car company the sleeping-car business.

WHEN the system of handling boats on the Chicago river by telephone was introduced by City-electrician Barrett, it was believed that delays to pedestrians and vehicles at the bridges would be lessened. A trial of the system proved the soundness of the conception, and a saving in time was effected. But by an ordinance passed some years ago the bridges were to be kept closed during specified hours in the morning and evening when the bulk of travel was passing across the bridges. This ordinance seems to have been set at defiance by those who have lately had charge of the vessel-dispatching station, and now there is complaint, especially from those who take suburban trains and who are obliged to cross anyone of the bridges, that they are frequently "bridged" during the prescribed hours for keeping the bridges closed, and thus are obliged to wait for later trains during the evening. The vessel interest is a great and wealthy interest, but on the other hand, as Mayor Roche said, "there are at least 700,000 persons in Chicago who have no interest in vessels," and a large part of that number cross the bridges. Strict adherence to Professor Barrett's original plan, and at the same time a strict observance of the city ordinance could be had and vessels be dispatched promptly, yet not to the detriment of those compelled to cross the river.

The article entitled "A Human Electric Generator" is an instance of a popular belief that some persons are more susceptible of electric excitement than others. It is no doubt true that persons of a highly sensitive organization are more affected by an electric shock than less sensitive persons, just as they would be by a nervous shock from any other source. But it is doubtful whether there is any great difference in different human bodies to act as electric generators. The body is a conductor, and unless insulated by clothing, carpeting, or other means, its electric potential is zero, the same as that of the earth Any person can generate sufficient electricity to light the gas by sparks from the finger tips, by shuffling along a woolen carpet. The electricity in this case is generated by friction, condensed on the body and given off to the metal gas fixture. The idea that this man had enough electricity stored up in his system during a thunderstorm to make him ever after a walking storage battery is simply ridiculous, and is to be attributed entirely to his ignorance and superstition, while his ability to generate electricity is doubtless due to some peculiarity of dress, probably to woolen clothing and heavy woolen socks insulating him from the earth, aided perhaps by dry, cold feet, due to his illness.

IT is understood that Cleveland members of the National Electric Light association will make strong efforts to secure the next midsummer convention in that city. Cleveland is a hospitable city; it is the home of some of the largest and most influential electrical concerns in the country who would be pleased at the opportunity of welcoming and generously entertaining the convention; it is a cool city in hot weather, and from its geographical location is easy of access for both eastern and western members. All these good features are duplicated in Chicago, and pride in our own city leads us to say that they are multiplied. Chicago would be only too well pleased to receive the association a year hence, and would guarantee to make the convention more welcome than any other city, but Chicago will not be greedy, inasmuch as it has the honor of having been the city in which the association was born and held its first meeting. Therefore, while we regretfully yield first choice for Chicago, we do so willingly in Cleveland's favor.

IN another column we give in as condensed shape as possible the results of an exhaustive study of the national fire loss. From these figures it will be seen that the incendiary caused 26 per cent. of the number of fires of known origin in 1886, and a trifle over 10 per cent of the total loss. In three years the defective flue caused about 20 per cent. of the 7,300 fires in dwelling-houses. Forest and prairie fires made the third best record, and matches the fourth. The ten principal causes of fire are: Incendiarism, defective flues, sparks in general, matches, lightning, lamp explosions, stoves, spontaneous combustion, lamp accidents (not explosions) and locomotive sparks.

How many of these devastating causes of the appalling total fire loss will the further development of electricity eliminate from the list? The incendiary will exist as long as the electric light burns, and he will remain a villainous factor in the problem. If, as a well-known electrician said but a few days ago, the next ten years will see electricity universally used for heating, will not the second cause—defective flues—be taken from its prominent position and placed near the other end of the list? Sparks in general—mainly from forest and prairie fires—can not at the present stage of electrical development be prevented by the electrician's art, but that art can certainly reduce the loss caused by matches, lightning, lamp explosions and accidents, and locomotive sparks.

If the electrician concluded his labors at the moment, contenting himself with the powerful, unvarying, brilliant, safe, yet cheap light he has given the world, if he had no thought of converting heat into electricity, transmitting it to other places and reconverting it into heat again, if he had no thought of stopping the enormous consumption of coal and water on the thousands and thousands of the whizzing locomotives rushing hither and thither across the country, casting their clouds of hot cinders into inflammable places, the world would owe him a deep debt of gratitude. But all these, and more, the electrician is bound to accomplish, and with his accomplishments will come the reduction of a large proportion of those causes which roll up the colossal fire loss that presents a startling array of figures.

IN a personal letter our Pacific slope correspondent writes enthusiastically of California as a field for the electric light and the electric motor. He speaks of the power furnished cheaply by the unfailing mountain streams and flowing artesian wells, and of cheap natural gas and petroleum for fuel. Referring particularly to motors for railways, he writes that the great drawback is the distance from manufacturers. "It takes from sixty to ninety days," he pens, "to fill an order. Thirty days more are consumed in transportation, and further, from ten to twenty days are required to get a return answer by mail in response to an inquiry. By the time that a company is formed, the equipment supplied and the road in running order, a year has passed." He notes a particular instance of an order for an incandescent light plant, which has been in the hands of a well-known and reliable concern in the east for four months, and shipment has not been made yet. He concludes that manufacturers in the east "have more orders than they can get away with." Nevertheless whenever there is a "boom" in real estate, companies are formed at once for electric lighting and electric railways.

That manufacturers are behind their orders is a gratifying state of trade, and that California is adopting the electric light and electric motor so widely—as is evident from the notes of our correspondent is also gratifying. "A year hence," writes our correspondent "twenty-five electric roads will be in operation in California."

SEPTEMBER 5th marks the date of another horrible holocaust in a theater in Exeter, England. One hundred and thirty bodies, so the cable reports, had been taken out of the ruins at the time of going to press. The origin of the fire is not stated, except that it was among the flies. When the fire started the drop curtain was lowered to prevent a draught, but the fire burst through the curtain and in a very few minutes the building was a mass of flames.

Thus another thrilling chapter has been added to history of calamitous theater fires. There will be an investigation as to the causes, perhaps blame will be laid on some person or persons, perhaps punishment will be inflicted, but the realization of these possibilities cannot fill desolated homes, replace the husband or father, the wife or children, atone for the loss of dear ones, or in any measurable degree compensate for an immense pecuniary loss. The scenes will be illustrated in thousands of papers and discussed in tens of thousands of homes. Time will fly swiftly by, and within a few short days the affair will become a matter of history and forgotten

save by those plunged in grief, until a recurrence of the disaster serves to recall the Exeter theater fire to mind.

There are methods of making theaters safe. The ingenuity of man has developed appliances that render places of public resort free from the dangers that beset them, particularly by fire. The chemist has evolved the non-combustible drop curtain. The electrician has produced the safe electric light, which can be used with impunity among the most inflammable materials. He has cunningly concealed in the ceiling of a hall the ever watchful, sleepless, unerring mercurial fire alarm. He has harnessed electricity and water together—an ever-ready extinguishing apparatus that floods the incipient blaze and quenches a fire in the early stages before it has become an uncontrollable destroying demon. Allied science and art have provided measures of safety that make public halls safe from the dangers of fire. Why have these appliances not been adopted more extensively? When will theater-goers demand that the fire-traps be converted into places of amusement that are not liable at a moment to be turned into the charnel-house or the funeral pyre? Now is the time.

The ounce of prevention so familiar to the mind should now be administered, and in good measure, and thus save the pound of cure which never will act as a remedy to hearts bowed down with grief, and homes laid waste by the occurrence of another theater fire.

Last week we recorded the victory achieved by the Board of Trade of Chicago over the bucket shops, by compelling the telegraph companies who had not agreed to discontinue service to bucket shops to take their choice between serving the board or the bucket-shops. It is now said that the bucket-shop men have retaliated by cutting wires. However, it scarcely seems possible to deprive the bucket shop men entirely of quotations solely on the ground of their inventive ability in discovering ways of avoiding both the law and the stringent rules laid down by the big board. To the disinterested observer the struggle between the two is amusing, to say the least.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number IX.

The Sperry Dynamo.—The Sperry dynamo presents some important features which deserve special notice. In the rotary movement of a

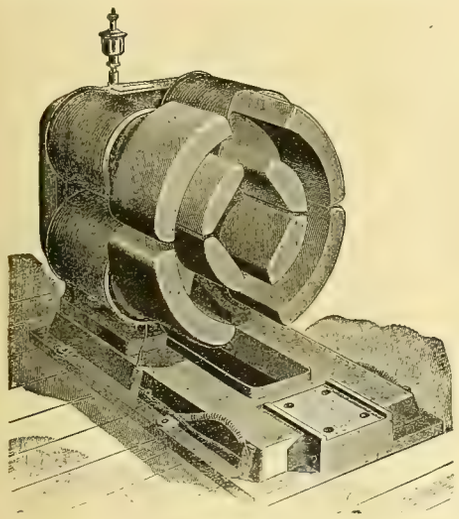

Fig. 21.

ring armature between opposite external poles pieces, the lines of force, according to one theory, enter the armature core and traverse the coils, producing an equal magnetic effect on every portion of each coil, interior as well as exterior. According to another theory only the exterior portion of the coils cuts the lines of force, the interior portion, as well as that on the ends, being practically idle, serving only as a conductor of the electricity generated in the exterior portion. To bring this idle portion into action the field magnets of the Sperry dynamo are constructed with interior as well as exterior pole pieces, the flat ring armature being nearly inclosed between them, by which means, it is claimed, about 92 per cent. of the armature wire is rendered effective, while without interior pole pieces only 30 to 54 per cent. becomes effective.

Fig. 21 represents the field magnets complete. They consist of two horse-shoe magnets, one at the right and the other at the left; the four cores being attached to a heavy iron yoke. From each core two pole pieces, like the tongues of a tuning fork, project horizontally, eight in all, four interior and four exterior, the two sets being arranged in two concentric circles as shown, leaving an annular space between them. The

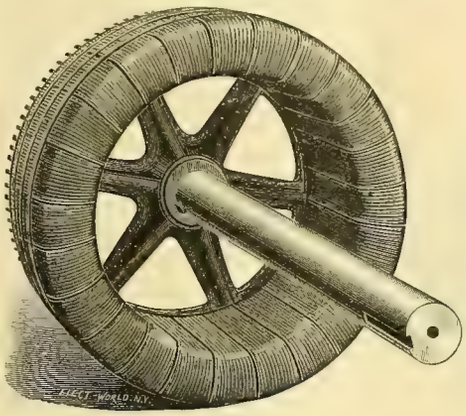

Fig 22.

armature, shown in Fig. 22, rotates in this space, its shaft passing through the centre of the magnet yoke. Its core has the same construction as that of the Edison, thin flat sheet iron rings, insulated with paper and bolted together, without air spaces. It is attached at the commutator end to a brass support called the spider, connected with the shaft. It is series wound in one closed circuit, with insulated copper wire of medium size, the coils being connected by radial arms with the commutator, in the usual manner; the ring complete being 8½ inches wide in the 35 arc-light machine. The shaft with the armature attached can be moved horizontally by means of a screw, and the armature drawn out of the inclosing pole pieces, and consequently out of magnetic field to any required extent, thereby reducing the magnetic and electric intensities.

The dynamo complete is shown in Fig. 23. The brushes, consisting of over-lapping flat copper strips, are attached to a movable yoke which has an automatic rotary movement controlled by an electro-magnetic regulator placed in the lamp circuit operating through a mechanical device, not shown in the cut, so that any variation in the electric resistance of this circuit changes the position of the brushes automatically with reference to the magnetic intensity of the field, and thus maintains the electric equilibrium; the brushes, by a rotary movement on the commutator, receding from the points of maximum intensity when a lamp is extinguished, and approaching those points when a lamp is relighted.

This is a constant current dynamo, series wound, the field magnets, wound with large wire, being included in the lamp circuit. It is claimed that an increase of 45 per cent. in electric current is obtained by the use of the interior pole pieces; a dynamo of twenty-arc light power with this construction being reduced to one of eleven-arc light power without it.

It is evident that in a flat ring armature like this, with air circulating on all sides of it, air circulation in the interior of the core is of less consequence than in a drum armature. It is also evident that the passage of lines of force without effect across the interior of the ring is impossible in an armature with interior pole pieces to intercept and utilize them.

It should be distinctly understood that in the rotation of an armature in the magnetic field the generation of electric currents in its coils depends more on the difference of magnetic intensity in different parts of the field, and the difference in the number of lines of force embraced within the coils in consequence of their relative position at different points with reference to those lines, than on the actual number of lines so embraced. This matter was discussed in No. II. of this series, and it was there shown that if an armature rotated in a perfectly uniform field, with its axis of rotation and the axes of its coils constantly parallel to the lines of force there would be no difference of magnetic or electric potential and hence no electric current. It has also been shown that the continued current of the dynamo is composed of a succession of transitory currents, and the point to be especially noticed is this, that these currents are generated by the difference of magnetic intensity as the coils pass through different parts of the field and occupy different positions. Hence, the points of maximum electric intensity are where the greatest amount of difference occurs, and not where the greatest number of lines of force traverse the coils.

It should also be noticed that it is not essential to the generation of an electric current that the wire should be in the form of a coil; a straight wire, or one bent into any conceivable shape, if carried through a field of varying magnetic intensity by rotation, or any other form of movement, will have electric currents generated in it, whether it passes from greater to less or from less to greater magnetic intensity. One chief advantage of a coil consists in its embracing a constantly varying number of lines of force when the plane of rotation is parallel to those lines and the plane of the coil at right angles to them, as in most ring and drum armatures; so that a coil rotating in this manner in a perfectly uniform field is subject to a constant variation, of magnetic and electric intensity, while the magnetism surrounding a straight wire cutting the lines of force in such a field, without rotation of the wire on its axis, would be everywhere perfectly uniform, and no electric current would be generated.

Another advantage of the coil consists in its capability of inclosing an iron core which by its magnetic conductivity, as has been shown, intercepts and leads the lines of force through the coil, generating electricity in every portion of it, an effect which would be impossible in a straight wire cutting the lines of force.

It is evident however, that in the absence of interior pole pieces, the interior wire of the coil being farther removed from the direct influence of the field magnets, both north and south, than the exterior wire, by the thickness of the ring, there is a reduction of this direct influence on the interior wire, represented numerically by the square of this distance; while with interior as well as exterior pole pieces the effects are practically equal. It is further evident that a perfectly

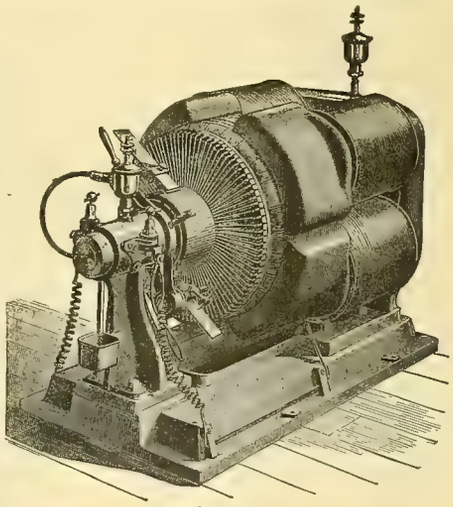

Fig. 23.

uniform field between opposite north and south poles is a practical impossibility, magnetic intensity, north or south, decreasing from one pole to the other as the square of the distance.

Captain Plessner, of Stuttgart, has invented an instrument called "The Antiphone," which is designed to protect the ear against hurtful and unwelcome sounds. By deadening undesirable sounds it is said to afford great relief to invalids, nervous persons, workers in metals, and particularly those whose occupations require them to sleep in daytime.

The Hill Friction Clutches.

The Hill friction clutches, which have been largely introduced in electric light plants, particularly in the west, are illustrated on this page. Clutch "A," or Fig 1, is made with either two or four arms, according to the amount of power to be transmitted. The pulley shown in the figure referred to has a clutch ring cast, not bolted, to the arms of the pulley. This ring is turned and finished absolutely true, and is grasped on the outer and inner sides by the eight clutch members, which are shod with thoroughly seasoned maple. The radial motion of the jaws, or clutch members, is produced by the

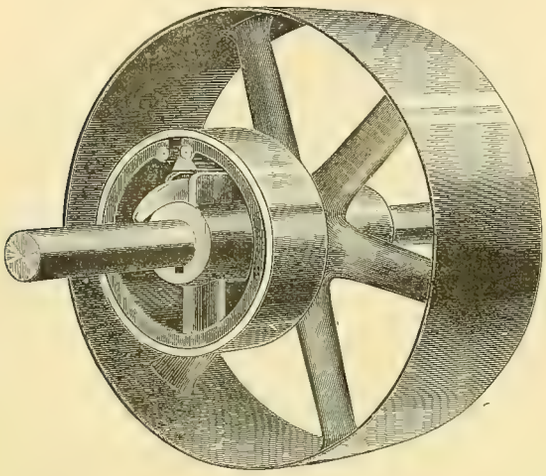

Fig. 2.

sliding collar, seen to the left of clutch, being pushed toward the clutch, operating the link and two angle levers with which it is connected with the clutch jaws, in such a manner as to force the outer jaws inwardly and the inner jaws outwardly, until they grip firmly both sides of the ring, and also so that the sliding collar cannot be kicked out. By moving the sliding collar out by means of a long lever attached to it, the jaws or frictional surfaces are instantly disengaged. The clutch is operated very easily and without start or jar to the machinery, and is key-seated securely to the shaft. The pulley, of course, runs loose on the shaft. It is nicely finished and accurately balanced, and fitted with an automatic grease cup, and the Hill patent split removable sleeve or bushing, which for high speed is babbitted with the best babbitt metal. The great value of a sleeve of this kind in a loose pulley is evident. The slight wear on the wood jaws may be taken up by set screws, and when worn out they can be renewed. All parts of these clutches are made strictly to gauge, and duplicates of any part may be ordered by number to take the place of those worn out or broken by accident, and the new parts will fit in their place as perfectly as the old ones. The interchangeability of all like parts of these clutches is a guarantee of their careful and accurate workmanship, and is something new in the clutch business.

The new Hill clutch "B," Fig. 2, has been on the market only a short time, but has met with favor on account of its extreme simplicity. This clutch supplements the "A" clutch, which is only made as small as 18 inches diameter, while the "B" clutch is made as small as six inches diameter. The operation of this clutch can be seen at a glance. The clutch consists of an outer and inner ring. The outer ring is sometimes cast into the arms of the pulley, or, as shown in illustration, fastened to the hub of the pulley. The pulley with the outer ring runs loose on the shaft, while the inner ring is key-seated securely to the shaft. The clutch is operated by means of a sliding collar being pushed up against the small lever. The small lever forces up a wedge which expands the inner ring against the outer ring, holding the same securely. The clutch is fitted with an automatic grease cup which lubricates the frictional surfaces and prevents wear, but this does not in any way prevent its holding firmly.

Fig. 3 is an illustration of the Hill clutch coupling "B". Friction cut-off couplings of the "A" style are manufactured as well, and are very largely used in electric lighting.

The new works of the manufacturers of these clutches, completed during the latter part of 1886, are already running night and day, to keep up with the demand. The factory is fitted with special machinery and appliances, and all the work passes under the personal supervision of the inventor and patentee of the clutches, H. W. Hill.

Electro-Deposition of Iron.

In a paper read by Prof. W. Chandler Roberts-Austen, F.R.S., before the British Iron and Steel institute, the author described the methods he adopted to form a deposit of iron by means of an electric current, and gave some interesting data regarding the quality of the iron so obtained. The electro-deposition of iron is not a new art, and it has, in fact, already been practised in Russia for the manufacture of iron types, from which the Russian bank notes are printed. One of these plates was shown to the meeting. But, as regards England, Professor Austen is probably the first who has succeeded in an operation which presents some unusual difficulties. The secret of his success seems to be the very feeble current which he employs. He uses a wrought iron anode placed opposite a cathode at a distance of about 1½ inches, and for a surface of about 70 square inches the current employed is only .089 of an ampère, given by two Smee cells coupled in series. The solution is a mixture of ferrous sulphate and magnesia sulphate. With so feeble a current the deposition naturally proceeds at a very slow rate. The matrix for the jubilee medallion, which was shown, took three weeks to produce. The procedure is as follows: The cathode is of copper, on which a thin coating of nickel has been electrolytically deposited. This is left in the air to slightly oxidize; then it receives a second deposit of nickel, and upon that the iron is thrown

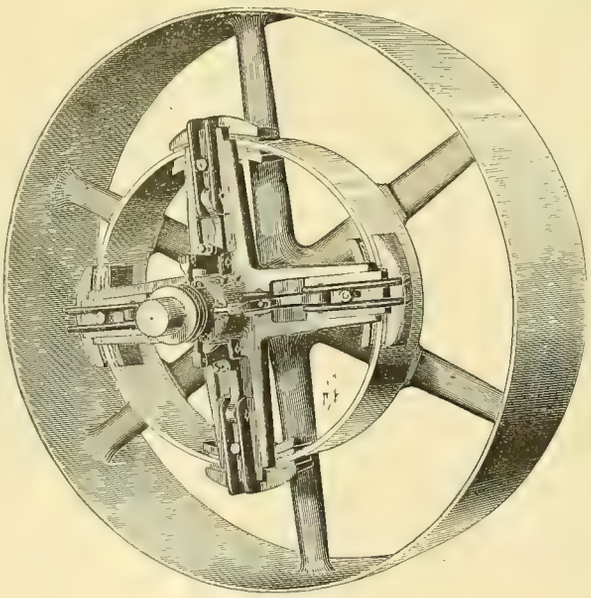

Fig. 1.

down. The chemical and magnetic properties of the iron so deposited are very remarkable; it is almost chemically pure, containing only a very slight trace of magnesium and .005 per cent. of sulphur. Its density when taken out of the bath is 7.675, but after annealing the density rises to 7.811, while at the same time a contraction in length of about one per cent. takes place. The magnetic susceptibility of the unannealing iron is surprisingly low, and that of the annealing sample is only about two-thirds of the value generally found for Russian soft wrought iron. The low density and low magnetic susceptibility are probably attributable to the large amount of occluded hydrogen which during the process of annealing is driven off, with a corresponding improvement in the quality of the metal. Professor Austen also showed a plate of iron on which copper had been deposited. To the back of the iron plate was then glued a piece of wood and the deposit of copper was stripped off, but the split occurred, not between the junction of the iron and copper, as might be expected, but within the copper itself, leaving a portion of that metal firmly adhering to the iron plate. This

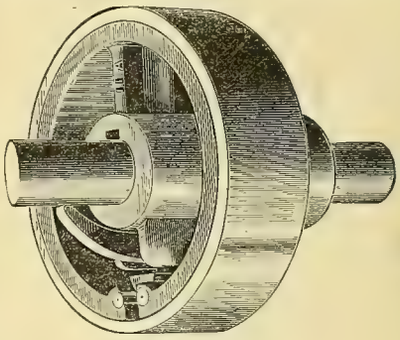

Fig. 3.

shows that the cohesion between molecules of iron and copper, when the latter has been deposited electrolytically on the former, is greater than that between the copper molecules among themselves.

Competition of Motors for Electric Lighting.

In December last the English Council of the Society of Arts invited manufacturers of steam engines, gas engines, hydraulic and other motors to submit prime movers not exceeding 20 h. p. to practical tests, and offered two gold and four silver medals for those machines which, in the opinion of a committee of judges, would appear to be most suitable for electric light installations. The tests were to be made in May or June this year. The notice given was rather short, and as a sufficient number of makers did not enter into competition, the council have issued a new set of conditions, under which the trials will be postponed until May or June, 1888, while the time of entry has been extended to December 31st of this year. The following are the new conditions of trial. They are practically the same as the original conditions, but two more gold medals have been added to the prizes, and compressed air motors, as well as exhaustion motors, have been included in the list:

"The Council of the Society of Arts are prepared to award four gold medals and four silver medals for prime motors suitable for electric light installations. The medals will be awarded on the results of practical tests, the conditions for which are as follows: 1. The motors will be divided into two classes, A and B. Two gold and two silver medals will be allotted to each class.

"(A) Motors in which the working agent is also produced.—*Steam:* Ordinary portable or semi-portable non-condensing engines; ordinary portable or semi-portable condensing engines. *Gas:* Coal gas or water gas with producer; hydrocarbon vapor; liquid hydrocarbon.

"(B) Motors to which the working agent must be supplied.—*Steam:* Detached engines, non-condensing, without boilers; detached engines, condensing, without boilers. *Gas:* Engines worked by illuminating or other gas. *Hydraulic:* Water motors. *Air:* Compressed air motors; exhaustion motors. 2. Each class will be subdivided into two groups—those declared to develop not more than 10 h.p., and those which will develop more than 10 h.p. and less than 20 h.p. Each motor will be worked at or about the power at which it is entered. [The horse power here mentioned is equivalent to

33,000 lbs. raised 1 ft. high in one minute, as measured on the brake.] 3. For 4 h.p. and under, the entrance fee will be £10; above 4 h.p., the entrance fee will be £2. 10s. per h.p.; the fees to be paid on entry. 4. No competition will be held unless ten motors at least are entered. 5. In case of no competition being held, the entrance fee will be returned. 6. The council reserve the right of refusing any entry. 7. All engines and boilers must be fitted up in accordance with the regulations of the Royal Agricultural Society, viz.: (*a*) All motors or producers subjected to more than a nominal pressure must be fitted with a pressure gauge; before any motor can be worked, the pressure gauge must be verified by the judges. (*b*) There is no restriction as to the construction of motors, boilers, or producers, but the judges must be satisfied that the bursting strength of them is at least four times the working pressure, and that a hydraulic test of one and a half times the working pressure has been satisfactorily applied, if considered desirable. (*c*) Each exhibitor must declare the greatest pressure at which he proposes to work his motor. (*d*) No old boilers, that is, boilers that have manifestly been at work for a considerable time, will be admitted without special thorough examination and a certificate of safety from the judges. (*e*) Each boiler, of whatever form or size, must be provided with the following mountings: Two safety valves, each of sufficient size to let off all the steam the boiler can generate, without allowing the pressure to rise 10 per cent. above the pressure to which the valve is set; two sets of gauges for ascertaining the water level; one steam pressure gauge, which must be tested and verified by the judges before the boiler can be used; a half-inch cock, terminating in a half inch male gas thread, for the purpose of receiving a testing pump; one check feed valve, immediately attached to the boiler, in addition to the ordinary pump valves, whenever the feed is introduced below the lowest safe water level, or where there is a length of feed pipe between the engine and boiler. (*f*) The judges reserve to themselves the power of affixing any gauges that the peculiar nature of the machinery may call for, with the object of insuring safety and of obtaining information. (*g*) Exhibitors must be provided with all the appliances necessary for taking the working parts of the machinery to pieces, for examination, should the judges require it. (*h*) Shafting, belts, gearing, high speed machinery, and any other exhibits likely to prove dangerous, shall be securely fenced and protected to the satisfaction of the judges, but such approval shall not relieve the exhibitor from his own liability. 8. The points of merit considered of the greatest importance are: (*a*) Regularity of speed under varying loads; (*b*) regularity of speed during the various parts of one revolution, or one cycle of revolutions; (*c*) power of automatically varying speed to suit arc lights; (*d*) noiselessness; (*e*) first cost; (*f*) cost of running; (*g*) cost of maintenance. [In estimating the comparative value to be allotted to each of these points of merit, the judges will give due consideration to the characteristics of each kind of motor, steam, gas, water, etc.] 9. The tests will be carried out under the direction of three judges appointed by the Council of the Society of Arts, who will report to the council, and will confer with them on the awards. 10. The council will publish the awards in the journal of the Society of Arts. They reserve the right of publishing descriptions of any of the motors, and the competitors must afford every facility for this purpose. 11. The competitors must take upon themselves, in exoneration of the society, all claims in respect of damage (if any) resulting from the testings, and must renounce all claims for compensation for any injuries, real or imaginary, that they may incur from alleged or actual imperfection in the arrangements of the testings, or from any statement in the report or description published. 12. The competition will take place in London about May or June, 1888. Entries must be sent in by December 31st, 1887. 13. All costs of fitting up and working the motors must be borne by the exhibitor. The society will provide the brakes, indicators, and apparatus, electrical and other, necessary for making the tests. 14. The council reserve the right of withholding any or all the medals."

CORRESPONDENCE.

New York Notes.

New York, Sept. 3.—The recent sale of the Baltimore & Ohio Express company to the United States company has aroused new interest in the future of the Baltimore & Ohio telegraph. The extension of the railroad from Baltimore to Philadelphia has already absorbed a large amount of capital, while the Staten Island project will also require at least as much more. Mr. Gould will be ready to take the telegraph system when he can obtain it on his own terms. He is a very patient man, and in cases of this kind instead of going out gunning for his game, he waits until it gets thoroughly tamed by long fasting, when he gathers it in as an act of charity. It is reported by interested parties that the Baltimore & Ohio Telegraph company is a revenue earning institution, but well seasoned telegraph men cannot understand how such can be the case with the prevailing tariff to depend on.

Electric railroading has received another set back by the Daft company's failure to complete its contract in starting the street railway at Asbury Park, N. J., by the middle of July. The season has now practically ended, and the authorities of the borough have decided to make a formal demand on Monday next for the $6,000 forfeit deposited in the bank. The Daft company also executed a bond for $10,000, which was to guarantee a forfeit of $200 per day for each day's delay after the deposit was eaten up. The commissioners feel very sore over the affair, and although inclined to be lenient at the outset, they will doubtless endeavor to obtain all the compensation possible now that the summer is past, and the railway is not completed.

Modern civilization has produced no more thrilling scene than the alarm of fire in a city and the rapid concentration of steam and horse power under the direction and control of our brave and gallant firemen. Such a scene has been chosen by Joseph Arthur as the culminating point in his new play, "The Still Alarm," which was brought out at the Fourteenth street theater Tuesday night. The hero is a fireman, and the woman he loves is in the power of a villain, who, when exposure is threatened, sets fire to the house in which the heroine is living and cuts the fire alarm wires. The "still alarm" comes in at the engine house over the telephone circuit. In response to the inquiry, "What's the matter with your wires?" the hero, Jack Manly, rushes to the test box and exclaims, "My God, they are cut!" He then seizes a hammer, strikes the alarm by hand on the gong, and at the signal the whole stage is transformed into a living representation of the interior of an engine house as the bell strikes. The crash of the horses hoofs, the click of the harness snaps, the procession of sliding forms down the pole from their bunks above, Jack Manly's shout "let her go," as he springs to the driver's seat, and the excited galloping horses whirl the smoking steamer across the stage and disappear, make a vivid and realistic picture. The whole interest of the play is centered in the arrival of the engine at the fire in season, and of course it gets there. The entire scene is perfectly arranged, and its first appearance produced a decided sensation. It will appear in the west in a few days, and will doubtless be thoroughly appreciated by all who enjoy a thrill of excitement when they go to a "show."

The Stock exchange authorities are making another of their spasmodic efforts to squelch the bucket shops. There has been a long season of dullness which has led to the appointment of a committee to ascertain the cause and suggest a remedy. A purse of $2,000 has been raised to endeavor to suppress the guerrillas by legal process. It is safe to predict that the bucket shops will survive, or at least a portion of them, and it is said they derive a considerable share of their support from members of the Stock exchange. It never appears to occur to these gentlemen that the "brokerage" business may be overdone. They have made no public protest against the enormous office rents which they are obliged to pay. They have made no effort to secure their share of the "unearned increment," which fattens all the landlords in the vicinity of the exchange. They have, however, made the most of their own bailiwick, and have levied on every telegraph company doing business in the exchange, so that in some cases the net telegraph earnings are *nil*. Let us have a meeting of the Anti-Poverty society on Wall street, with a speech by Dr. McGlynn from the sub-treasury steps. No more effective send-off to the labor campaign could be desired. P.

From the Pacific Slope.

San Francisco, August 28.—At Long Beach, Los Angeles county, a contract has been let to build an electric road along the beach to the mouth of the river at Rattlesnake island, returning by the way of First street to the park. The tracks are now down, as there has been a steam motor running for some time. As soon as the conductors are up the electric cars will be put on. Five cars, some of them observation cars, are now being built for this road. Electric lights will be strung along the line of road and along the beach. The bathing-houses will be lighted by arc lights and the Beach hotel by incandescent lights. The power will be obtained at Orange. This power will also be used for the town of Orange and surrounding towns for lighting and power, as they have an ample supply of water.

Los Angeles has the honor of having the first electric railway west of Denver. The cars were built by J. G. Brill & Co., of Philadelphia. They are very neat in construction and each has a seating capacity for forty-five persons. At times as many as seventy-five have been carried on a single car. The Daft overhead system of transmission is used. During the time that the road has been running not an accident has happened or the road failed once. The cars run at the rate of from ten to twelve miles an hour, and have run as rapidly as twenty miles an hour. Fifteen hundred passengers have been carried in one afternoon, with only three cars, a distance of three miles. There are several other roads now in construction, and before the year is up Los Angeles will have three or four electric roads in operation.

Chico, a town of 9,000 inhabitants, wants electric lights, but is deterred from putting them in on account of the price of fuel. The water company will, however, tap the Feather river in the mountains and bring the water over to Big Chico creek or Butte creek, whence it will again be taken up by a large ditch or canal and carried down to the land to be irrigated; but before being used for irrigation a water wheel will be put in at the foot of the fall obtained and and power rented for electric or other purposes. It is stated that another company intends to put in pipes and bring the water down from the mountains into this city and put in an electric power and light station, and in addition use the water for irrigating purposes. If either of these schemes are carried out it will no doubt build up the city and valley.

The new building of Pierce & Morse at San Diego was lighted by the electric light on the 19th ult. This plant consists of Westinghouse engines and Edison dynamos. There are 375 lights in the building and 35 outside. The cost of the building was $140,000.

The chief engineer of the Shanghai Electric Light Co., at Shanghai, China, was recently killed by getting caught under one of the belts of the station.

Virginia City, Nev., has been asking for sometime for some enterprising company to take hold and give them lights. At last Messrs. Hobert & Hayward have taken the business in hand, and they are preparing to put in a 100-arc light plant and a 1,500 incandescent light plant. It will be running inside of sixty days. They will secure their power from the pipe line near the new water mill of the Nevada Mill & Mining Co., in the southern part of the city. The numerous stamp mills and mines and mining buildings, and a city with a population of 15,000, coupled with the cheapness of the never-failing water power, will combine to make this as large and profitable a plant as there is on the Pacific coast. The same firm intends to put in motors for blacksmith fans, etc., and to transmit power up the hill sides for hoisting purposes in the mines, where they are too high to use water power. S.

Indianapolis Items.

INDIANAPOLIS, Ind., Sept. 3.—The Nordyke & Marmon company, mill manufacturers, have the contract for and are working on a flouring mill to go to Nebraska, which is to be run by two twenty horse-power electric motors. One of the motors is to be placed in the lower part of the mill the other in upper part, thus bringing the power as near as possible to where it is needed. The current will be supplied from the Edison electric lighting station which at present is idle during the day. Its estimated cost for power will be in neighborhood of one dollar an hour, which is reasonable compared with cost of coal or other fuel.

Judge Noyes, of South Bend, Ind., this week denied the motion for a permanent injunction in the case of the Central Union Telephone company, whose poles and wires were being removed from streets and alleys by the city marshal under orders of the common council, as reported last week. He said the question was one of municipal power; he could find no law to sustain the city council in granting a permanent right to occupy the streets and alleys by any corporation. It is reported that the telephone people are trying to compromise with their patrons and continue business, but are not meeting with much encouragement.

Thursday of this week suit was filed in the Federal court by the American Bell Telephone company and Central Union Telephone company against a number of persons in the northern part of the state, who at present are using the Cushman telephone. Among them are Charles Miller, Jacob Wile, Jno. H. Organ, Edward Moore and others of Laporte, Ind., and A. R. Colborne of Michigan City. Infringement of the Bell patent is claimed.

Telephone matters in this vicinity are improving. The Central Union company have nearly eight hundred instruments in use in this city—a larger number than at any time since the three dollar law went into effect. Before the passage of that law there were nearly 1,100 subscribers, and Indianapolis enjoyed the distinction of having the best equipped exchange and giving better service and for less money than any city in the country.

It has been reported by some of the daily papers here that there were some 65 telephones in use at the Insane hospital, while the truth of the matter is there are half a dozen telephones and the remainder of the number is made up of speaking tubes connecting the different parts of the immense buildings.

The daily papers state that Wallace, inventor of the Wallace telephone, who came here some three years ago and tried to introduce his instrument, during the telephone trouble caused by the three dollar law, has gotten himself into trouble in Canada. A number of Indianapolis gentlemen because interested in the instrument and a company was organized to go to work immediately, building lines and establishing an exchange. The matter was delayed for one reason and another, and finally dropped out of sight.

M.

Detroit's Budget.

DETROIT, Mich., Sept. 3.—The Woodward Electrical company, capital stock $1,000,000, has filed its articles of association. The purpose defined is "to own and operate, or dispose of in whole or in part, certain electrical patents; to manufacture and vend or lease certain electrical batteries, primary and secondary; to manufacture and sell stored electrical energy for motive, lighting, and other purposes; and to own and operate, or dispose of, in whole or in part, a new and useful thermopile for generating electricity, and to deal in electrical goods generally." Of the 40,000 shares of capital stock, the inventor, Henry Woodward, of London, England, holds 16,000. The new enterprise will be located in Detroit.

The Michigan Cushman Telephone Co. has been incorporated, capital stock $50,000; head office, Charlotte, Mich. The incorporators are: Benajah W. Warren, Charlotte, Mich.; Thomas H. Bottomley, Capac; John Evans, Bellevue; Daniel P. Sagendorph, Charlotte; Walter S. Powers, Nashville.

The Telephone & Telegraph Construction Co. is putting into a four-inch wooden pipe one of the Standard Underground Co.'s 50-conductor cables, 1,800 feet long. When this work is completed, the Telephone company will have in the neighborhood of 9,000 feet of cable underground here.

C.

THE ELECTRIC LIGHT.

According to information furnished by those on the ground, Kansas towns are only waiting to have some one present the electric light to adopt it.

Los Angeles is lighted entirely by the electric light at present. There are seventeen masts each 150 feet in height, fourteen masts 16 feet in height and about 200 arc lights.

In Madrid, Spain, the electric light is making good progress, although, as yet, there is no central station for public supply. Private isolated installations are fairly frequent. Two large installations will shortly be given out to tender. One is the prison, where upwards of 1,400 lights will be required, and where the present annual cost of lighting by gas amounts to £4,800. The other is the Royal Opera house, where a still greater number of lights will be required. In both cases a large saving is expected from the adoption of the electric light.

"Undergrounding of wires seems to be on the boom everywhere except in New York," writes a tourist who has been visiting the larger cities of the middle and eastern states.

The Imperial Russian Technical society is to hold an exhibition of lighting appliances at St. Petersburg towards the end of the current year. The programme will include: (*a*) Historical collections of apparatus and material serving for lighting in ancient times; (*b*) lighting by solid and liquid materials of vegetable and animal origin; (*c*) gas lighting materials, and apparatus for its manufacture and use; (*d*) lighting by electricity; (*e*) special sources of light; (*f*) lamps for burning mineral oils; (*g*) photometry; (*h*) mineral oils and their derivatives, apparatus and contrivances for procuring, preserving, transporting and treating mineral oils; (*i*) heating apparatus fed by mineral oils and their derivatives; (*j*) mineral oils for lubricating.

It is stated as a curious effect of the electric light that in several of the public buildings in Washington its use has led to an enormous increase in the number of spiders' webs. The lights attract multitudes of insects, and the insects in turn attract the spiders. It is complained that in many cases architectural outlines have become badly obscured.

The business part of Canton, Ill., was lighted by electric light the night of September 3d, for the first time.

The Association of Fire Underwriters, of Baltimore, Md., have called for the removal of all overhead telegraph, telephone and electric light wires, on the ground that they obstruct the firemen and that the latter wires in particular are dangerous.

An electric light plant is being placed in the Sierra Butte company's sixty-stamp mill at Sierra City.

The electric light was installed at the beginning of June in the large hotels in Engelberg, in various places in the Berner-Oberland, on the lake of Lucerne; and also at Schaffhausen, where the fall of the Rhine is every night brilliantly illuminated with arc lights. In this case the power is supplied from a turbine driven by the stream. In most places in Switzerland water power is obtainable at a small initial expenditure, and this circumstances naturally facilitates the introduction of the electric light very considerably.

Electric lighting was recently introduced at the Central Railway station, Christiana, very successfully. In Christiana the gas works are city property, and the corporation is now going in for an electric light plant of its own. The steamers running along the west coast of Norway have been fitted up with Edison installations. In Stockholm the leading theatre is now lighted by electricity, and the city of Gothenberg, Sweden, is to have its streets lighted by electricity.

THE ELECTRIC MOTOR.

In an English patent, granted A. Schanschieff, Gipsy Hill, Surrey, relating to the electric motor, the armature is described as follows: The armature is constructed by placing very soft iron wires in a cylinder so that the wires in a section taken at right angles to the axis represents the magnetic lines of iron filings freely falling from a sheet of paper placed over a magnet. The cylinder is then filled with a diamagnetic substance. The armature so prepared, when in the presence of the field magnets, is polarized on rotating around its axis. The field magnets are called into activity successively and maintain the rotary motion of the armature. The electro-magnets are prepared in the same way. Steel is substituted for iron, and a very strong permanent magnet is thus obtained, which is much lighter than any now made of equal power. According to another part of this invention, a series of soft iron plates are mounted upon the wheel, which is to be driven to serve as armatures. These plates are so arranged as to be equi-distant from the center of the wheel and all in the same plane, which is a plane of rotation. There are radial intervals which separate one plate or armature from another. Parallel with the wheel is arranged a frame which does not rotate, but is provided with radial arms. These arms are one less or more in number than the armatures, and each of them carries an electro-magnet, so that its poles are in close proximity to the path of the armatures. There is a commutator on the axis of the wheel, and this brings the electro-magnets successively into circuit. The magnets are adjustable on the radial arms, and are set to and from the center to suit the load upon the wheel.

The New Orleans *Picayune* man indicates one of the disadvantages of fans propelled by the electric motor. Says he: "The electric motor fans have worked revolutions and evolutions in beer saloons. The man who refused a room and dinner and all things in a hotel after registering—saying he merely wanted to 'arrive,' and have his name reported—is nothing to the seedy man who sits in a beer saloon, neglecting to buy beer or anything else, saying he wants to be fanned. Beating a saloon out of beer is an old trick; the latest is to occupy seats in a saloon where the fans are working and deadbeat the proprietor out of wind."

Some of the directors of the Madrid, Spain, Tramway company are striving to substitute the electric motor for horse traction. The latter is not only costly, but may lead to trouble with the town authorities. The company have hitherto been in the habit of stationing relays of horses in certain places in the town where additional tractive force is required on account of the steepness of the street; but the municipality have attempted to prevent the company from continuing this practice, and, after a good deal of negotiation, it was arranged that the company may, upon payment of a certain sum, be allowed to keep their horses standing in the streets as hitherto. A number of the directors are dissatisfied with the new arrangement, and look to the electric motor as a solution of the matter.

THE TELEGRAPH.

In the main office of the Western Union company, in New York city, presided over by W. J. Dealy, there are but about 500 telegraphers employed, while the number of messages handled in one day has reached 109,000. The daily average, however, for the latter will not go beyond 90,000 messages. It has been estimated that the entire daily business of New York city, handled by all companies, exclusive of press, will not fall short of 300,000 messages. To handle this business there are employed less than 1,000 telegraphers.

The Netherlands Indian government will, it is said, make provision for stretching a telegraph line across Sumatra from west to east to continue the existing lines to Deli. There is some talk also of laying a cable from Situboudo, in Java, to Macassar, in Celebes, via Bali Buleling. Borneo and other principal islands in the Netherlands Indian colonies are at present cut off from all telegraphic communication.

It is said that the longest regular land circuit in the world is a Western Union wire running from

New York to Galveston, Texas, a distance of 2,000 miles. It often happens that there are several storms on this wire at the same time, but it performs its daily labor without interruption or delay as a usual thing.

A dispatch from China brings the news of a terrible plague of sudden death which is raging at Nankin. It says: "People are dying in every quarter, and there are many instances of very sudden deaths. People are apparently well in the morning and dead in the afternoon. The Hu Pac says that over 1,000 telegraph poles belonging to the Munanan Mingtaz district and Kweichow Lane line have been pulled down by the people, who say that the telegraph is a diabolical European artifice."

A cable will shortly be laid between Hayti and Cuba.

The night force on the Western Press circuit will receive $30.50, with no extra, for seven nights work per week hereafter, which is a slight advance over the old wages. The day force receives $25 per week.

THE TELEPHONE.

The following are the latest statistics showing the position of the telephone service in Berlin: Number of subscribers, 6,000; length of wire, 12,000 kilometres; conversations per diem, 100,000; inter-urban communications, 1,500 to 2,000 per day.

A remarkable mechanical telephone was recently experimented with at Milford, Mass. It operates without the use of electricity. A loose wire was extended sixteen hundred feet from a transmitter to a tree with a loose end lying on the ground. Conversation was heard distinctly by simply placing a straw hat on the wire. Ordinary conversation was heard through a Derby hat as a receiver at a distance of sixty feet. Experiments were then tried with a transmitter at both ends, and ordinary conversation could be heard anywhere in the room, whispering, singing and music being easily distinguished. The transmitter contains a device for imparting to the tones of the voice a peculiar vibratory force, not only persistent, as against other vibratory forces, but easily controlled.

August 30th Judge Noyes, of Laporte, Ind., refused the Central Union Telephone company a permanent injunction to restrain Street-commissioner Butler and others from removing the company's poles and wires from the streets by order of the council.

Savoy, Ill., is now without telephone connection with the Champaign exchange.

I heard a story to-day, writes a New York correspondent, about the manner in which the telephone invention was originally offered around New York, without finding anybody to take it or furnish capital to promote it. Certain gentlemen secured an option on the telephone at one time, the terms of which would have given them its use in the entire United States for a royalty of not over $30,000 a year. Their part of the agreement was that they should establish exchanges in the leading cities and pay $2 royalty a year on each transmitter used, but in no event were they to pay over $30,000 a year. They were unable to raise the necessary money to start even one exchange before their option expired. Mayor Hewitt had an opportunity, it is said, to get the biggest end of the telephone for $20,000, and a controlling interest at about the same time was offered to the Western Union Telegraph company for $11,000. Ex-Gov. A. B. Cornell was acting president of the Western Union company at that time, Mr. Orton being abroad. When the use of the telephone was explained to Governor Cornell, he said: "The machine is all right, but what do men want to talk about?" Then he went on to argue that men would not be inclined to commit their secrets over a wire, where other people might hear them. Then he indicated that they would prefer to use written messages and enclose them in an envelope where nobody could see them and have them sent without danger of others knowing anything about them. Senator Don Cameron has denied the report that he was offered a fourth interest in the telephone for $5,000, but it was understood, nevertheless, that he was offered a big interest for a small sum of money and refused it. The figures may not be right, but the general fact has at least passed into current public belief.

NEW ENTERPRISES.

Charles Jorgenson, of Albert Lea, Minn., is building a store of two stories to cost $4,000. The electric light will probably be introduced.

At Maple Hill, Kans., George Fowler is building a frame residence at a cost of $12,000. Electric bells will be put in.

The Phil Best Brewing Co. will erect a business building in Kansas City, Mo., at a cost of $45,000, from plans by M. J. Scholer, architect, of the same city.

At Sioux City, Iowa, the C., M. & St. P. Ry. Co. will erect an engine house and machine shops. L. D. Beardsley, of the same city, is division superintendent.

Henry Muehlbach, of Kansas City, Mo., will erect a three-story residence block at a cost of $75,000. Electric bells will be put in.

At St. John's, Mich., R. M. Steel will build a stone residence at a cost of $10,000. It will be provided with a fire alarm.

F. F. Willis, 619 E. 9th street, Kansas City, Mo., will build a handsome two and one-half story residence to cost $25,000. It will be provided with electric bells.

Detroit architects are now drawing plans for the new Mining School, at Houghton, Mich., The cost will be $75,000.

Miscellaneous Notes.

In an article published in one of the French scientific journals the writer states that, from a comparison made by him of the results of animal and steam power, as employed in France, at least, the first-named is really the cheaper motor; that is, in the conversion of chemical to mechanical energy, 90 per cent. was found to be lost in the machine, against 68 in the animal. He has also found that the steam horse power, contrary to the belief generally entertained, is often materially exceeded by that of the horse. Thus the cost of traction on the Mont Parnasse-Bastile line of railway, proved to be for each car, daily, some 57 francs, while the same work when performed by the horse cost not exceeding 47 francs. In view of these and similar facts bearing on the question, the conclusion arrived at is that, for moderate powers, the conversion of chemical to mechanical energy is more economically effected through animals than through steam engines.

The reports from the assessors of the various counties of California show a remarkable increase in property values in nearly every county, the total increase for the state reaching $132,000,000. Of all the counties Los Angeles stands first on the list, with an increase of $55,000,000 over last year, a gain of nearly 147 per cent. A certain portion of this is fictitious, representing the speculative values of a big boom in real estate, but the major part stands for solid improvement, which no collapse of the present insane gambling in corner lots can affect. The next county on the list is San Bernardino, with a gain of nearly $8,000,000, or 97 per cent. San Diego has had 88 per cent. of increase and Santa Barbara 75 per cent. Many of the northern countries show gains of from 10 to 25 per cent., while only about a half dozen mining counties show a marked decrease. San Francisco county shows an increase of nearly $22,000,000.

The future of the metropolis of America is a theme at all times and seasons fascinating. Before the end of the present century even there will be improvements and additions here that will seem in looking back to have been wrought by a necromancer. Just now some of the principal thoroughfares are barricaded by unsightly and ill-smelling piles of dirt and stones. Trenches are being dug, not in anticipation of a communistic uprising, but for a huge burial. The electric wires, caging the city like a gigantic spider's web in the air, are to go underground. There is no doubt about it. It must be done. Tremendous difficulties are in the way, and the way may be long and devious, but the end will be triumph and everybody will wonder why it was not reached long before. Imagine New York without an electric wire or telegraph pole in sight! ejaculates a New York correspondent. Its architectural beauties will be revealed for the first time—its fair proportions, contour and stateliness. There will be more and better air to breathe. The city will rise like a majestic lion released from its aggrauating net by the gnawing of the little subway mouse.

"When we began the present war on the bucket-shops," said President A. M. Wright, of the Board of Trade, to the *Herald* "Gossiper," "there were about six thousand of them in the country. The first difficulty was that these six thousand concerns paid the telegraph companies enormous revenues for private wires and general service. It was no easy matter to get the companies to help us, or even to not aid the shops. Colonel Clowry, of the Western Union, was the first man to take a broad view of the matter. He saw that the bucket-shop system had grown to such gigantic proportions that the commerce of the country was really being bucket-shopped; that the largest share of the business intended for the great legitimate exchanges was stopped *en route* and gambled in, and that, if the thing was allowed to go on, the exchanges would so languish that the telegraph companies would ultimately suffer worse than anybody else. It took the executive committee at New York some time to get around to this view of Colonel Clowry's, but it did finally. The Western Union authorities are now committed to the view that the vast and extraordinary business of gambling on the prices made at the great exchanges must be put down or the business of the future be seriously and permanently cut down. This view compels the cutting-off of an enormous present revenue and the upsetting and derangement of a vast system. All this cannot be done in a moment, but it is being accomplished with a great deal of speed nevertheless. In sixty days we have done so much toward exterminating the shops that in the west they are practically shut up. They are most of them still open, but so embarrassed that they are simply trying to hold together in the hope that the efforts against them will relax. So far our attacks are against the concerns in the west. We have taken no steps as yet against those in New York and elsewhere which are still getting quotations and sending them out. In New York State there are said to be, by those who have studied the matter, 1,000 bucket-shops. At New York City one concern employs 121 telegraph operators. It is the one operated by the old Chicago crowd, N. Q. Pope, Dan Loring and others. It happens that there is one shop at New York—Hammonds—which has, through neglect, a perpetual injunction against the Western Union depriving it of its quotations. It was to meet that very difficult case that we asked the board to change the rule governing the gathering and handling of quotations. If we had known in advance," said Mr. Wright, "of the vast proportions of the bucket-shop system, it is possible that we might at the start have been timid about undertaking its destruction; but having gotten into it, and after having made this progress, I do not hesitate to say that we shall in a short time have these concerns closed up, and for good."

Fifty years ago, when the president convened an extra session of congress because of commercial and industrial disasters culminating in panic, his message was delivered at noon, September 5th, at Washington; reached New York at 11 o'clock that night by special government express and part of the way by railroads just constructed; reached New Haven by steamboat at 5:30 the next morning; Worcester by horse express at 11:33, and Boston by rail at 12:38, taking but little over twenty-four hours for its transmission, which was considered an amazing triumph of advancing science. Now a message could be read before midday on the shores of the Pacific ocean if delivered at Washington at noon. This is only an illustration of the marvellous progress which fifty years has brought in all our commerce and our industries, and the advance of science has wrought such revolutions that the world of 1837 not only no longer exists, but is almost completely forgotten.

A full plant of the machinery for the Rae pro-

cess of amalgamation has been sold to the Drumlummon mine, Montana. It is a duplicate of that in use in the Douglass mill, Nev., and the Christy mill, Silver Reef, Utah.

The fire alarm telegraph wires of the city of Cleveland are to go underground. An order has already been placed for 6,000 feet of single wire cable. The three wires running to engine house number 10, on Doan street, will be conducted up Doan street to Cedar avenue through three cables, each 2,000 feet in length. A six inch sewer pipe will be laid in a trench about three feet and half deep, and the cables will then be drawn through.

Eighty-two patents a day for every working day in the year are granted in the patent office. In 1837, 436 patents were issued, while for the fiscal year ending June 30, 1886, 25,619 were issued. The statute of 1836 provided for the employment of six persons in the patent office besides the commissioner, and their aggregate annual salary was $6,850. The revenue of the office during 1837 was less than $30,000. To-day over six hundred persons are employed in the patent office; they are paid $650,000 in salaries, and the income of the office is at the rate of $1,250,000 a year.

During recent tests aluminum bronze containing about 11 per cent. of aluminum and silicon together, showed a tensile strength of from 95,000 to 119,000 pounds per square inch and an elastic limit of 70,000 to 85,000 pounds. A 9 per cent. aluminum bronze in castings showed, with great uniformity, from 70,000 to 80,000 pounds tensile strength, and an elongation of 30 to 40 per cent. and in some cases even 48 per cent. elongation. In compression these aluminum bronzes and brasses show equally remarkable results, the ultimate strength varying from 150,000 to 160,000 pounds per square inch.

Writing to *Science*, Prof. A. E. Dolbear says: "In your issue of Aug. 5th, Mr. M. A. Veeder points out some passages in Deschanel's textbook of physics, which he takes to imply that moist air is a good conductor of electricity, and that the earth is a reservoir of electricity; and then he asks, Has Deschanel been superseded? I do not happen to have the book referred to at hand, but it does not matter. It is true enough that one may complete an electric circuit through the earth, or through any part of it, when there is proper conducting material at the wire terminals, not otherwise. The earth, in such case, acts solely like a return wire to complete the electric circuit, and its sole function is conductivity between points that differ in electric potential. As most of the earth's surface is made of conducting materials, one may make connections for conduction almost anywhere, and it is a great convenience to be able to do so; but it does not follow that the earth stores up any electricity at all, so that it might be called a 'reservoir.' Electricity is but a transient phenemenon, and, when it does work in no other way, is changed at once into heat, in the earth as well as anywhere else. It is therefore improper and misleading to speak of the earth as a reservoir of electricity. As to the effect of a damp atmosphere upon electrical machines, it is well enough known that if means be provided for preventing the deposition of moisture upon the surface of such machines, by heating or otherwise, the machines may be kept electrified for an indefinite time. The electricity generated creeps over the damp surfaces of wood or wax or varnish to the earth, not through the air, whether moist or not. If moist air were a good conductor of electricity, or if it were one of the best conductors, as was stated by Mr. Garriott, it is highly probable that telegraph companies would have found it out long ago, and have had to insulate the wire from the air, instead of which they find it only necessary to insulate from the posts upon which the wires are hung. There is nothing new or strange about these things, except it be, that, having been patent to all for so long a time, they should be unknown to any who are pretentious enough to criticise the labors of those who work according to knowledge, and at the same time evolve out their consciousness a theory unsupported by a single experiment, and directly contradicted by all we do know."

Personal Paragraph.

F. W. Horne, western manager of the Excelsior company, is in the south looking after the interests of his company.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	385	400
Central Union	44	45
Michigan	72	73
Great Southern	28	30
Colorado	20	22
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27

Business Mention.

F. E. Degenhardt, western manager of the Standard Underground Cable company, has just closed some handsome contracts as follows: Two thousand seven hundred feet of 200-conductor cable and 8,000 feet of 100-conductor cable for the Chicago Telephone company; 13,920 feet for the Chicago Arc Light & Power company; 1,200 feet of three-wire anti-induction cable for the Central Electric company; 2,000 feet of 50-wire cable for the Telegraph & Telephone Construction company, of Detroit.

The Edison central station in Chicago will have four Heine safety boilers of 300-horse power each. They will have Jarvis patent furnaces and Sheffield grates, which have been contracted for of H. A. Glasier, manager of the western department of the company, 81 Lake street, Chicago. The furnaces will also be provided with Buttman automatic firing doors.

Last week the Lone Star Brewing company, of San Antonio, Tex., gave H. A. Glasier, western manager of the Jarvis Engineering company, 81 Lake street, Chicago, the third order for a Jarvis patent furnace, and also an order for a set of National rocking grate bars. The Jarvis company is now setting three boilers for Herrick Bros., of Minneapolis, Minn., on the Jarvis system. Screenings will be the fuel.

The Fort Wayne Jenney Electric Light company through the energy of Dr. E. A. Hutchins, the affable manager of the Archer Electric Manufacturing company, of Wichita, Kan., have just closed contracts for 400 sixteen candle power incandescent lights for Sterling, Kan., 300 sixteen candle power incandescent lights for Nickerson, Kan., 250 lights of the same candle power and 30 2,000 candle power arc lights for Peabody, Kan. The Fort Wayne company have opened an office in the City of Mexico, and have recently closed a contract for an installation in Toluca, Mexico.

The Archer Manufacturing company have just started their station for a 2,000 incandescent light plant of the Fort Wayne Jenney system. The building will be 50x140 feet, and of brick. The first floor will be devoted to the station, and the second and third floors to manufacturing purposes. This company is now building small dynamos of from ten to fifty-light of sixteen-candle power for use in private residences, and small motors of from one-half to two-horse power, to be run by storage battery. The dynamos and motors are of the Fort Wayne Jenney company's style. The Archer company is doing a thriving business in electric bells and annunciators.

The American system of electric lighting has gained quite a foothold in Philadelphia, heretofore occupied by other companies. After strong competition on the part of several companies for the contract to light the fine store of Messrs. Jacob Reed's Sons, of Philadelphia, the contract has just been awarded to the American company for thirty-five lights.

The streets of Joliet, Ill., are to be entirely lighted by the American system of electric lighting in place of gas and oil lamps. The present electric plant is to be overhauled and 200 new lights added to it immediately. It is said that it will be one of the finest electric light stations in the west when completed.

The Electrical Construction company, 171 Randolph street, Chicago, has been organized for the purpose of doing any kind of work in the line of electrical construction, from fitting a house with electric bells to installing an electric light plant. Manager Harter reports business very good.

One of the most interesting of catalogues is that of the Page Belting company, Concord, N. H. The process of making belts, from the receipt of the green hides to the finished roll, is graphically described, and the description is so well carried out by the profuse illustrations that the lay reader, even after a hasty perusal, feels that he knows how belts are made. The Page products in the belting line are too well-known to need commendation.

The Jenney Electric company, of Indianapolis, Ind., have issued a handsome lithograph of the new union passenger station at that city. The station is lighted by a plant of 1,100 incandescent lights and 60-arc lights.

W. J. Wark, western agent of the Empire City Electric company, of 15 Dey street, New York—a live, energetic business man, by the way, and a recent settler in Chicago—is meeting great success. The company he represents are in the electrical supply line, and by the merit and low cost of their goods are enabled to secure an ample share of the western trade.

Electrical Patents.

Issued August 30th, 1887.

368,931. System of Synchronism for Telegraphy. Gilbert A. Cassagnes, Paris, France.

368 948. Electro-magnetic Dental Mallet and Plugger. Philip Helmer, Clinton, Iowa.

368,955. Mast Arm for Hanging Electric Street Lamps. Francis H. Lacey, Atchison, Kans.

368,987. Conductor Tip. Schuyler S. Wheeler, New York, N. Y.

369,034. Galvanic Battery. John A. Seely, New York, N. Y. The cover of the battery consists of two or three thicknesses of canvas covered on both sides with a flexible coating of rubber, which is stretched over the jar like a cap.

369,036. Lightning Arrester. Elmer A. Sperry, Chicago, Ill. The device is designed primarily for a dynamo circuit. The novelty consists in a weight and chain connected with one of the serrated plates to separate the plates when fused and restore them to their normal position. It does not appear that the magnets, which release the weight, would necessarily be charged by the current which fused the plates, as seems to be assumed in the specification.

369,091. Manufacture of Incandescent Electric Lamp Filaments. Alexander Bernsten, London, England, The invention consists in coating a carbon filament with an infusible oxide of metal by immersing the carbon in an alcoholic solution of the salt of the same metal and passing an electric current through the filament so as to raise it to a high temperature.

369,121. Method of Making Impervious the Joints of the Lead Pipe of Electric Cables. William R. Patterson, Chicago, Ill.

369,122. Test Circuits for Telephone Cables. William R. Patterson, Chicago, Ill.

369,144. Manufacture of Electrical Conductors. John J. Williamson, Boston, Mass.

369,194. Electric Arc Lamp. Osborn P. Loomis, Somerville, Mass.

369,219. Electric Generator. Leonidas G. Wooley, Grand Rapids, Mich.

369,238. Joint for Telegraphic Wires. David P. Emminger, Philadelphia, Pa.

369,256. Electric Speaking Telephone. Morris Martin, Malden, Mass. The soft iron core is rigidly mounted within the rubber core in close proximity to the steel magnet, but is not rigidly attached to the steel magnet, as heretofore. The adjustment of the core with respect to the diaphragm is thus not affected by changes in the length of the permanent magnet due to heat and cold.

369,259. Insulating Telegraph Cables. William R. Patterson, Chicago, Ill. The insulating fiber, preferably before it is carded or spun, is moistened with salt water so as to leave, when dried, an inert, harmless, poorly conducting salt uniformly distributed throughout the fiber. Plumbago dust may be sprinkled on the fiber, instead of the salt solution. The object of the invention is to uniformly reduce the insulation of the wires so as to prevent the retention of the static charge and so avoid cross-talk in the working of long telephone cables.

369,267. Process of Treating Filaments for Incandescent Lights. Edward P. Thompson, Elizabeth, N. J. The filaments are soaked in a saccharine solution in the usual way, and then coated with a film of wax for the purpose of preventing the filaments from sticking to the mold of the carbonizing crucible.

369,280. System of Electrical Distribution. Thomas A. Edison, Menlo Park, N. J. The invention is a grand multiple arc system and is described especially in connection with incandescent electric lamps. It is equally applicable to motor systems. Its object is to safely and economically distribute from a central point large quantities of electricity for light and power.

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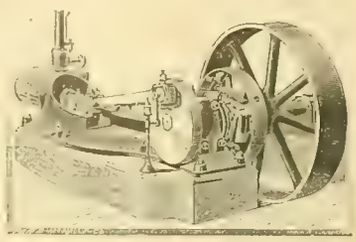

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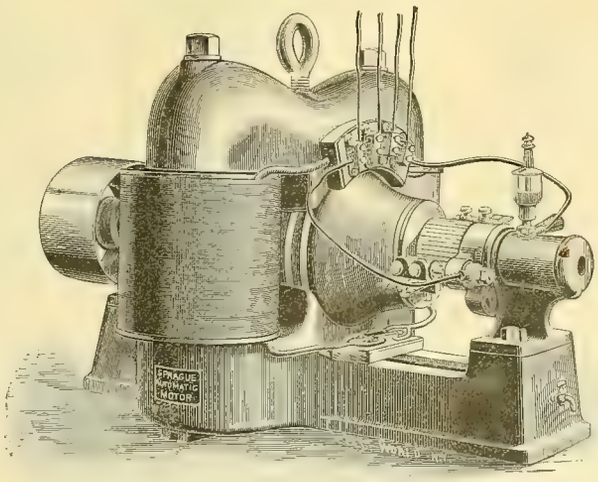

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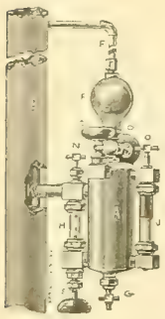

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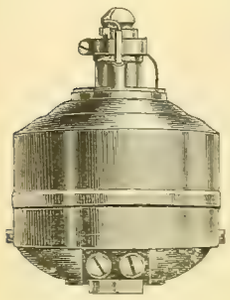

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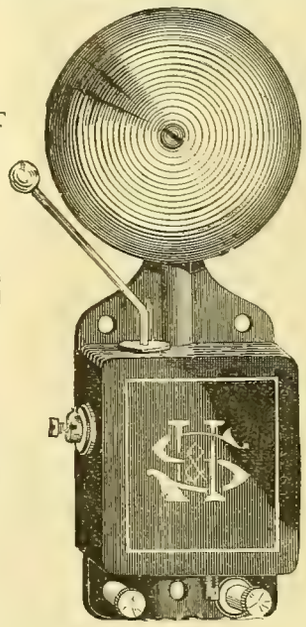

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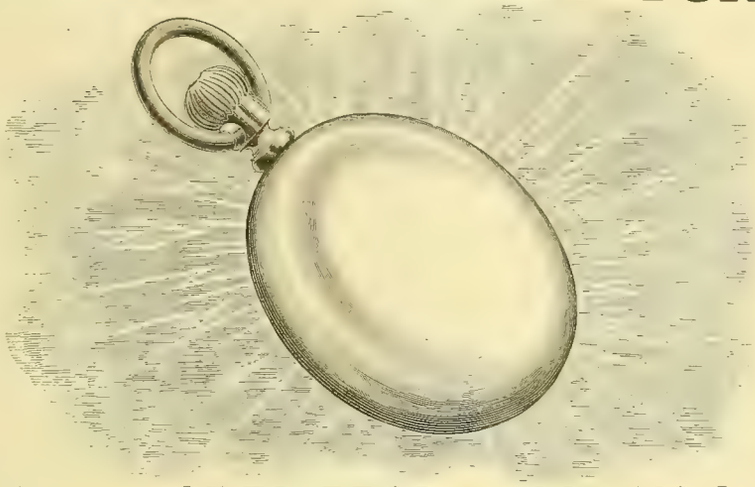

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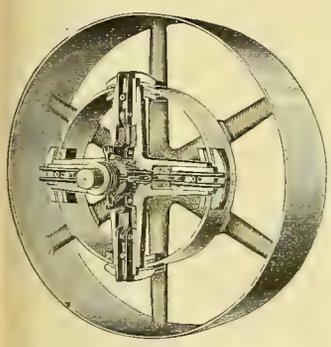

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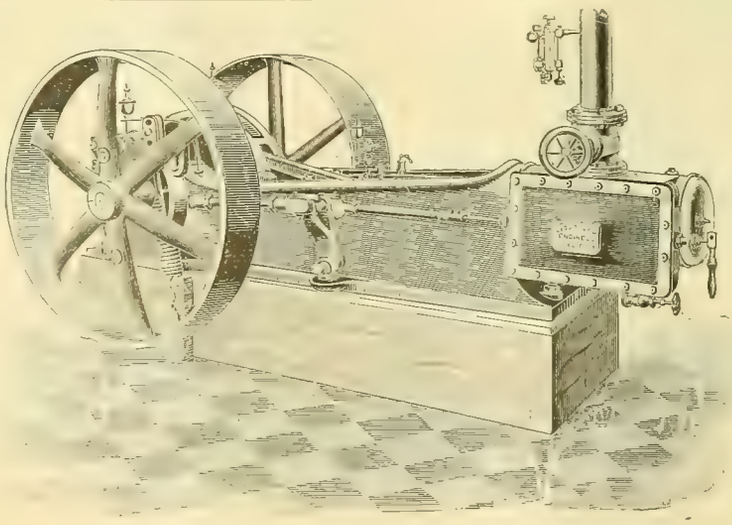

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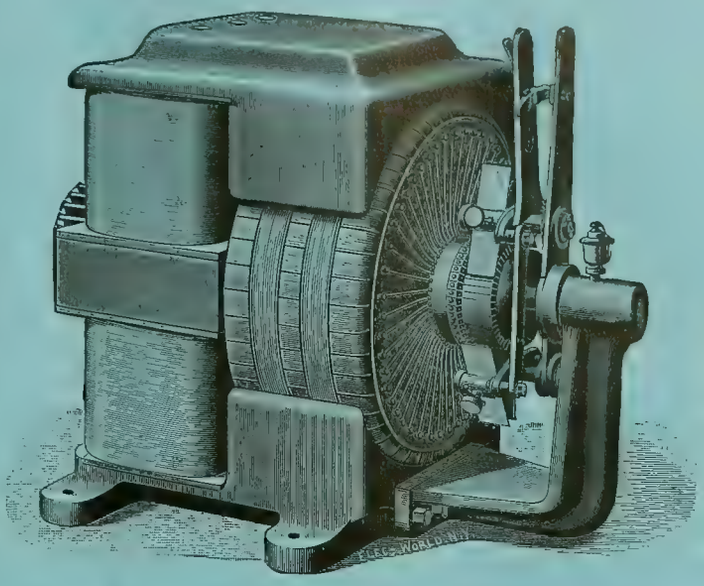

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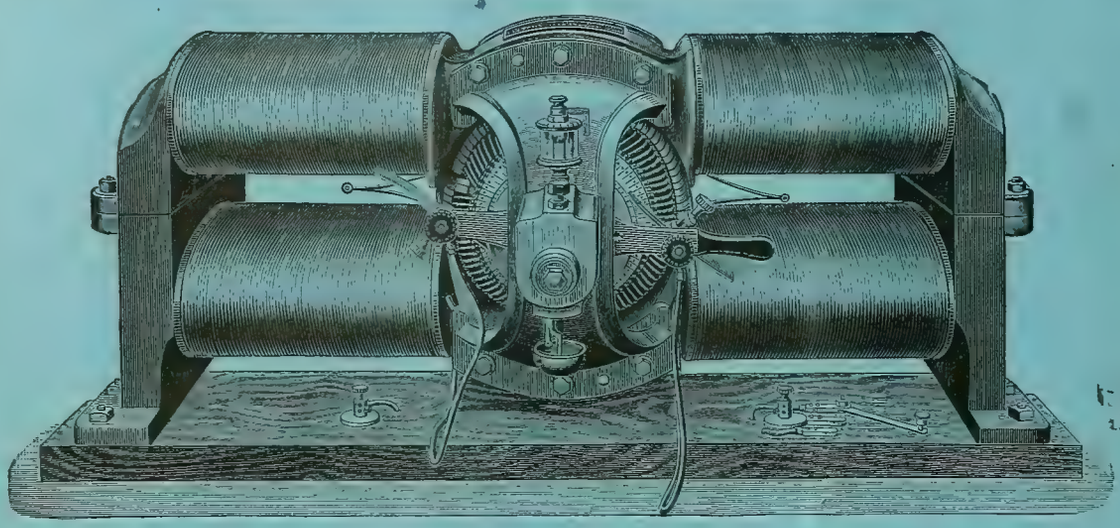

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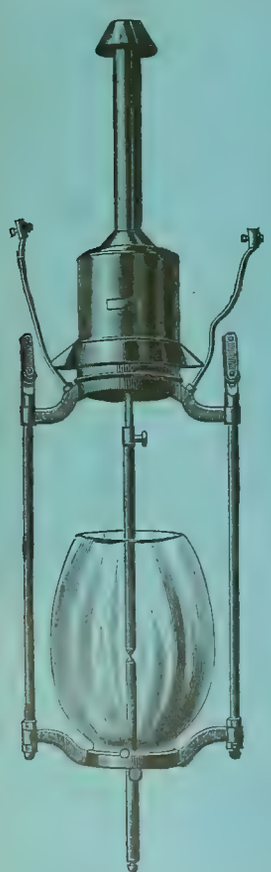

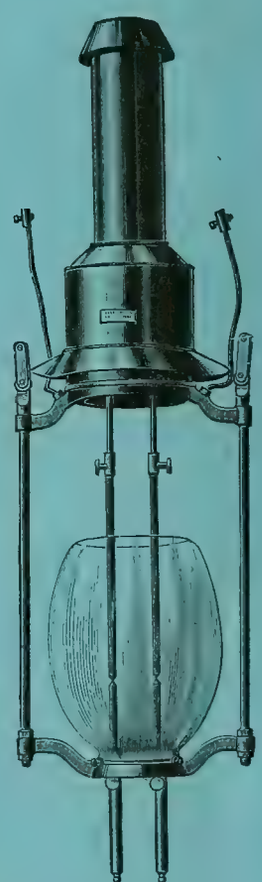

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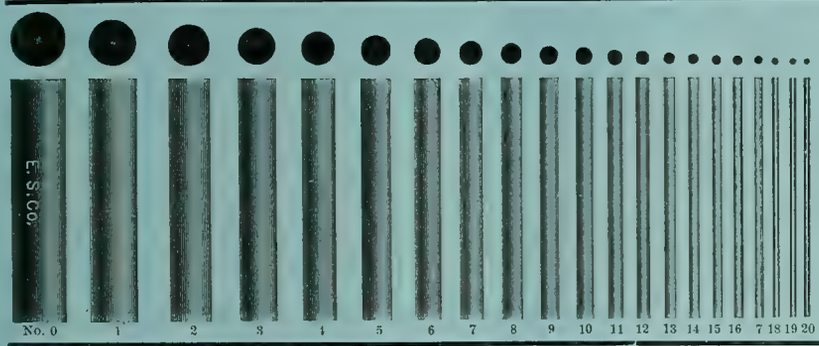

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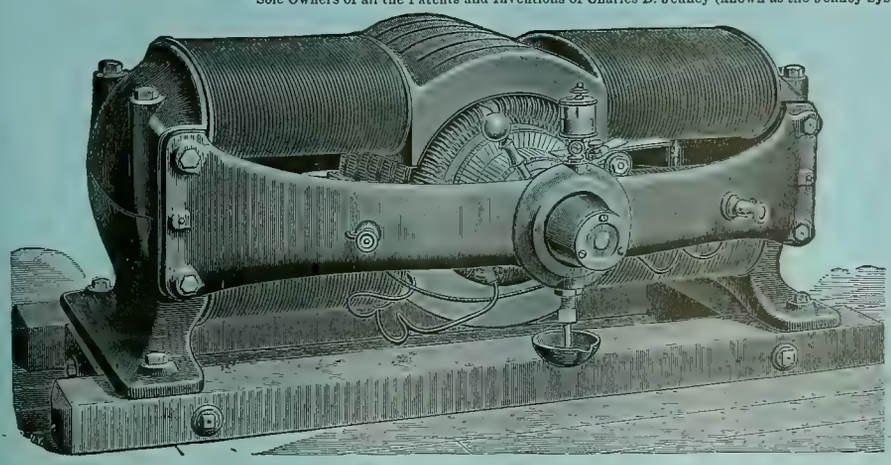

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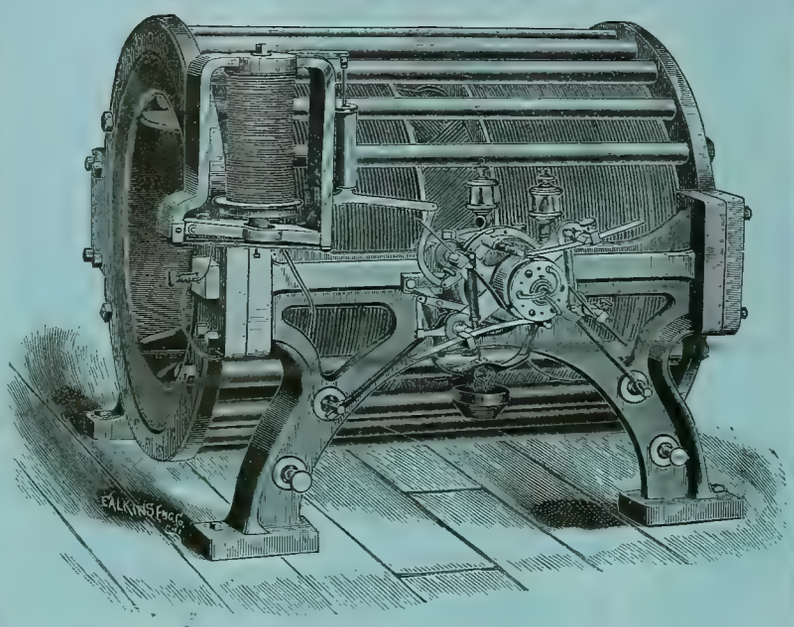
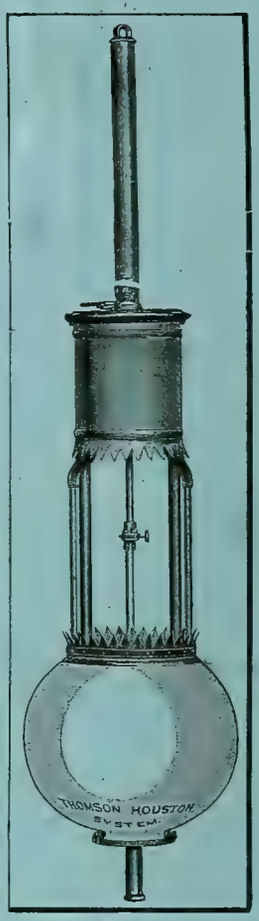
The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

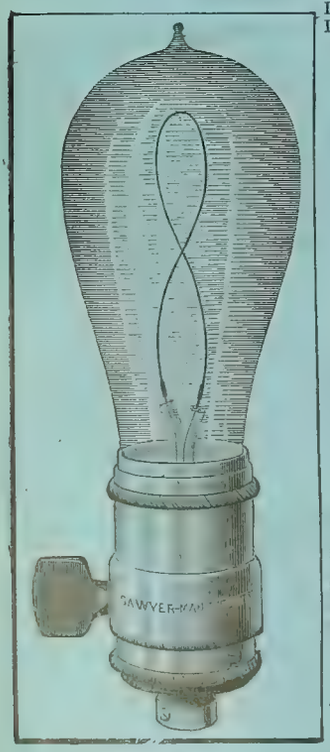


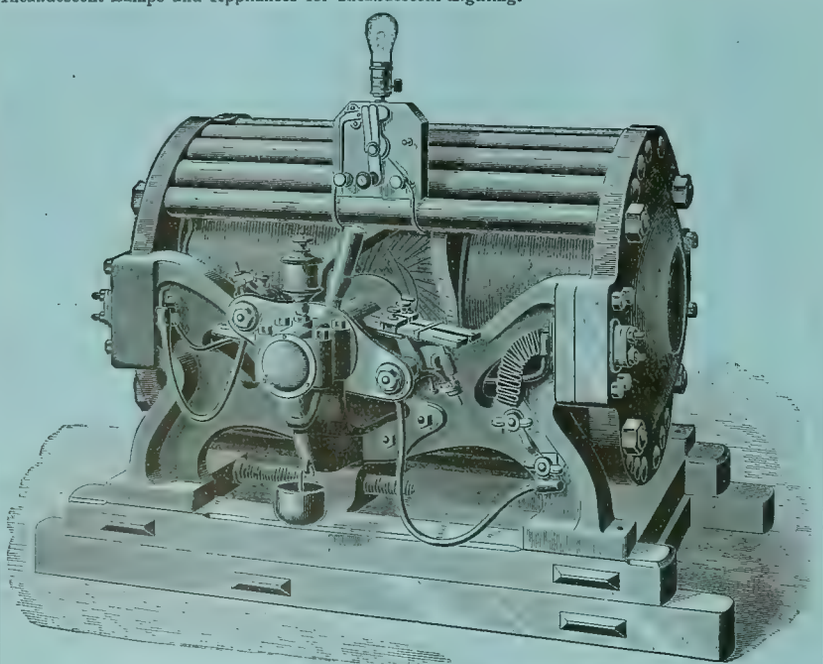
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

GEO D. ALLEN, GEN'L MGR., WM. HOCHHAUSEN, SUP'T AND ELECTRICIAN.

Excelsior Electric Company,

9 Dey Street, New York. Factory, 204 to 216 Willoughby Street, Brooklyn, N. Y.

Excelsior Electric Light

TO THE FRONT

By reason of its new Automatic Regulator that does not depend on merely shifting the brushes, but cuts out a portion of the field magnets as each light is turned off, saving the power in proportion to number lights burning down to one light.

Dynamo is the simplest of all makes and requires no attention except to keep it clean. The lamps are ornamental, can be used in connection with any system from seven to fifteen amperes without change of magnets.

The first and only system where Incandescent lights are successfully running off Arc Light Circuits.

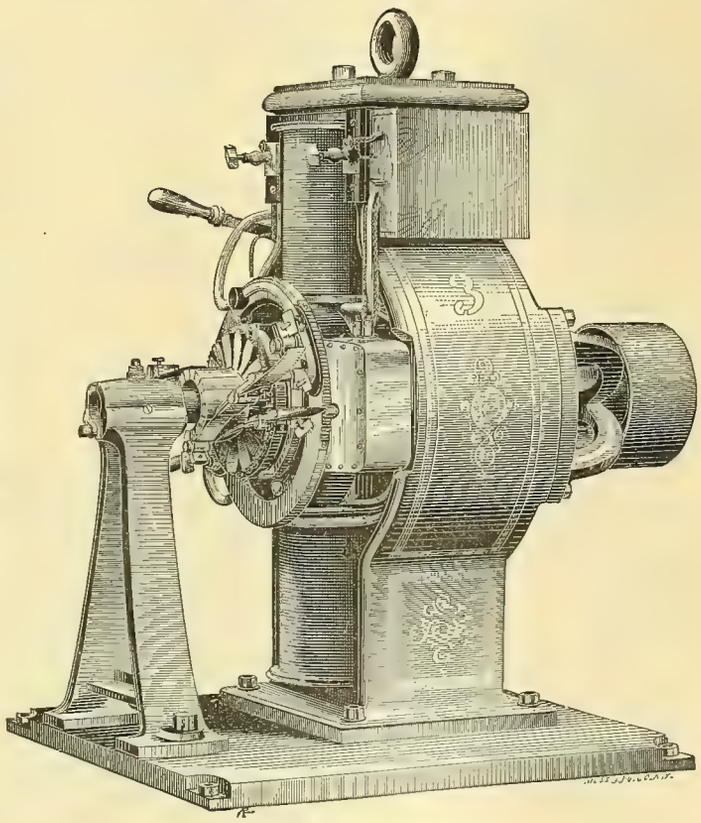
Twenty five dollars will repair our dynamo in places that cost seven hundred dollars on other systems.

Our system is original, and not copied after foreign obsolete patterns.

Our prices are reasonable.

The only system that has local companies paying 40 per cent and above on its capital stock.

We take the contract wherever we bid.



Excelsior Electric Co.,

185 Dearborn Street, Rooms 13 and 14. CHICAGO, ILL.

REYNOLDS' IMPROVED CORLISS.

THE IDEAL ENGINE FOR ELECTRIC LIGHT WORK.

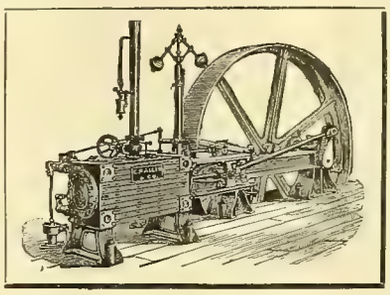
Unequaled for Close Regulation

—AND—

ECONOMY OF FUEL.

Write for our Catalogue and Circular giving List of Users.

—SOLE BUILDERS—



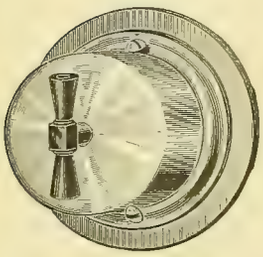
We refer to the following electric light plants now using the Reynolds' Corliss:
Brush Electric Light and Power Co., Cleveland, O.
Edison Electric Light and Power Co., Rockford, Ill.
Syracuse Electric Light Co., Syracuse, N. Y.
Louisiana Electric Light and Power Co., New Orleans, La., three engines.
Badger Illuminating Co., Milwaukee, Wis., two engines.
West Side Power Co., Minneapolis, Minn., four engines.
Louisville Electric Light Co., Louisville, Ky.
La Crosse Brush Electric Light and Power Co., La Crosse, Wis.
C., M. & St. P. R. R., Milwaukee, Wis.
Menominee Mining Co., Iron Mountain, Mich.
West Hotel, Minneapolis, Minn.
Plankinton House, Milwaukee, Wis.
N. W. Mutual Life Insurance Co., Milwaukee, Wis.
J. V. Farwell & Co., Chicago, Ill.
Chas. H. Slack, Chicago, Ill.
Mandel Brothers, Chicago, Ill.
C. Boetcher, Leadville, Col.
Omaha Thomson-Houston Electric Light Co., Omaha, Neb.
Thomson-Houston Electric Co., Racine, Wis.
Sioux Falls Electric Light and Power Co., Sioux Falls, Dakota.
Electric and Water Supply Co., Neillsville, Wis.

EDW. P. ALLIS & CO., RELIANCE WORKS, MILWAUKEE, WIS.

CHICAGO BRANCH: 48 South Canal Street.

FOREST CITY ELECTRIC WORKS,

MANUFACTURERS OF

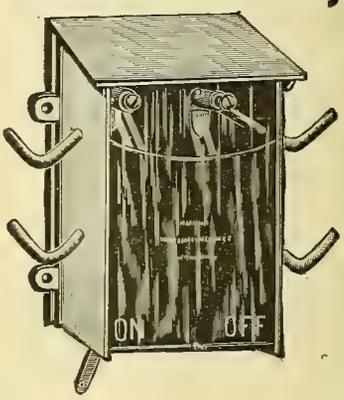


Cleveland's Electric Light Cut-outs,

GANG SWITCHES, FROM 5 TO 40 AMPORES.

Quick Make and Break Uncontrolled by the Handle.

Correspondence Solicited with Electric Light Companies.



W. B. CLEVELAND, Proprietor,

26 S. WATER STREET, CLEVELAND, O.

FARADAY CARBON COMPANY, LIMITED

CAPACITY, 1,000,000 CARBONS MONTHLY.

QUALITY GUARANTEED EQUAL TO ANY IN THE MARKET.

LOW PRICE LIBERAL DISCOUNT ON LARGE ORDERS. CORRESPONDENCE SOLICITED.

PITTSBURGH, PA.

NEW ❋ YORK ❋ SAFETY ❋ STEAM ❋ POWER ❋ CO.

BUILDERS OF HIGH GRADE SELF-CONTAINED

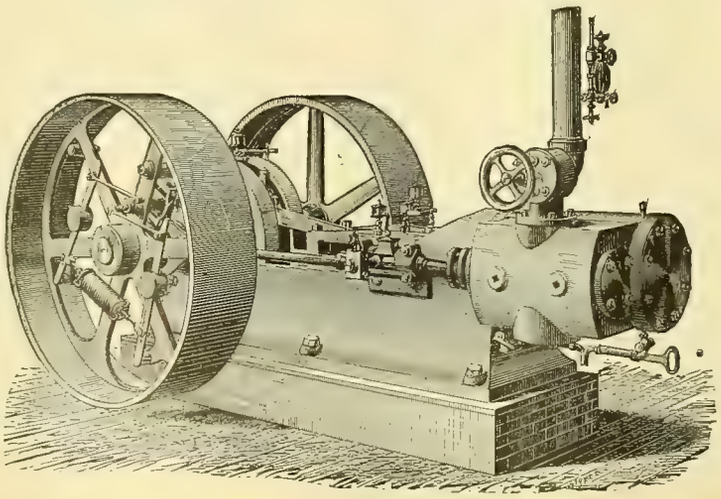
AUTOMATIC

Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC LIGHTS

And other duty requiring close regulation of speed.



ADVANTAGES:

Great strength without excessive weight,
Small space required.
Simplicity of construction.
Accessibility of all parts.

ESTIMATES CHEERFULLY FURNISHED.

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64 & 66 S. CANAL ST.,

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ENGINEERS AND CONTRACTORS OF

Steam and Hydraulic Machinery.

Complete Steam Plants for Electric Light and Power.

Western Agents for Armington & Sims' Engines, Steel Tubular Boilers, Jarvis' Patent Furnace, National Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Jenkins' Bros. Valves, Etc. Also, Brick and Pipe Work, and Belting.

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25 PARK PLACE, NEW YORK.

MANUFACTURERS OF

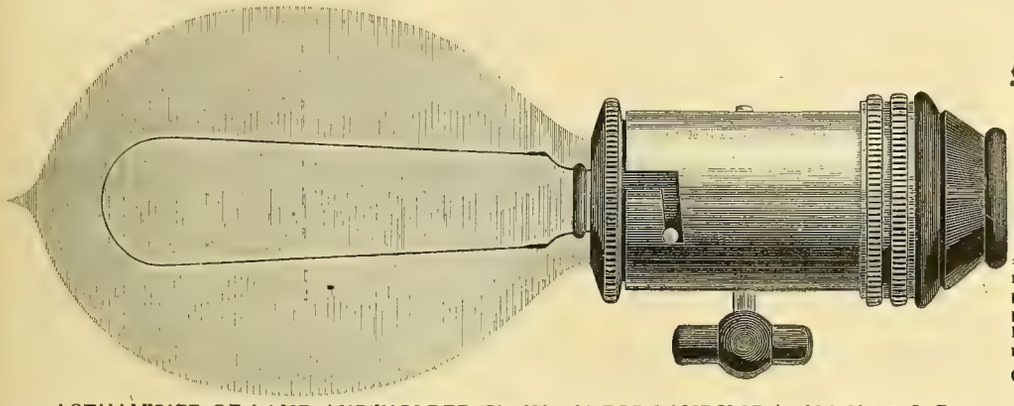
Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

Western Agency, 185 & 187 Dearborn St., Chicago.



ACTUAL SIZE OF LAMP AND HOLDER (Size No. 1,) FOR LAMPS 65 to 100 V. 16 C. P.

Aluminous Incandescent.

We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

CORRESPONDENCE REQUESTED.
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Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode. Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the *works*, they require no shield or other protection.

Ask your jeweler for them. Send for Catalogue.

Geneva Non-Magnetic Watch Co., L'd.

177 and 179 Broadway, NEW YORK.

Our BELTING is tanned on the surfaces only; the **INTERIOR is RAW HIDE.**

Send for Our Valuable Book for Engineers and Belt Users. Free.

Agents in all Cities. Send for Trial Belt.

Our Belts are the strongest, most even and perfect Electric Belts made.

ST. LOUIS, MO.

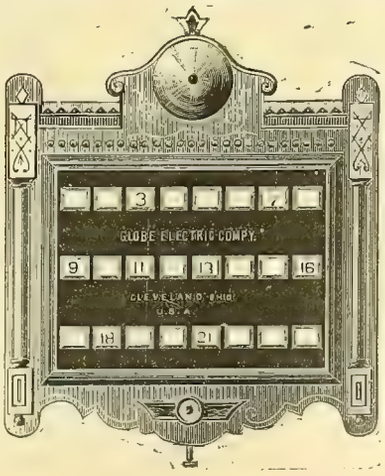
THE GLOBE ELECTRIC COMP'Y,

Wholesale Manufacturers of Every Description of Apparatus for

TELEPHONE COMPANIES,

SWITCH-BOARDS, SWITCHES,

Annunciators and Bell Supplies a Specialty.



The Globe House and Cole Drop Annunciators

Which are of the Best Material and Workmanship, are Perfect in Action, Simple in Construction, Elegant in Design, and Low in Cost. In addition they possess many other important advantages which are wanting in other Annunciators.

4 Indicators	$12 00	40 Indicators	$ 74 00
6 "	16 00	50 "	92 00
8 "	20 00	60 "	106 00
10 "	24 00	70 "	121 00
12 "	29 00	80 "	132 00
15 "	36 00	90 "	145 00
20 "	44 00	100 "	155 00
30 "	57 00		

With Alarm $3.00 Extra, Subject—

THE GLOBE ELECTRIC COMPANY,
CLEVELAND, OHIO, U. S. A.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

Telegraph and Telephone Apparatus and Supplies

THE BEST OF EVERYTHING AT BOTTOM PRICES.

DETROIT ELECTRICAL WORKS,

MANUFACTURERS OF

Electric Supplies

INCLUDING

Medical Batteries, Skeleton, Iron and Box Bells, Burglar Alarms, Hotel and House Annunciators, Fire Alarm Boxes, Pins and Brackets, Insulated, Magnet, Telephone and Electric Light Wire.

BUILDERS OF

Fisher's Electric Motors,

AND ALL APPLIANCES FOR CITY AND SUBURBAN

ELECTRIC RAILWAYS.

General Offices and Works, - - DETROIT, MICHIGAN.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE STILLMAN.
PRIVATE OFFICE
EUCLID AVENUE
CLEVELAND, O.
THE ONLY FIRE PROOF HOTEL IN THE CITY
ELECTRIC INCANDESCENT LAMPS THROUGHOUT
J. WARREN COLEMAN JR. MANAGER.

Cleveland, O. May 25th 1887

C. C. Warren, Mgr.
Us Electric Lighting Co., Chicago.

Dear Sir:— It always gives us pleasure to communicate ~~to communicate~~ the working of our electric light plant, which has been in operation since Oct. 1st 1885. For more than a year not a cubic foot of gas has been burned in The Stillman. We have the electric lights in every room, and can depend upon them absolutely. There has rarely been a stoppage, and never a serious interruption of the current, although the machinery is in continuous operation night and day.

The light undoubtedly costs less than gas; but were such not the case the avoidance of smoke and heat, and the saving of oxygen would make make it preferable.

Very truly yours,
The Stillman Co.
by H. P. Gill, Key. Sec.

ST. GEORGE HOTEL
THE PRIVATE OFFICE OF
D. J. Mackey & E. P. Huston,
Evansville, Ind. May 5 1887.

Mr. C. C. Warren Mgr
The United States Electric Lighting Co,
Dear Sir:

We started the 'Electric Light Plant' you placed in our hotel April 2nd 1886 and have run the same continuously ever since we use no gas. Our hotel being entirely and perfectly lighted by your system. We have had but little trouble and have always been able to adjust anything that got out of order ourselves.

We believe your light the acme of perfection and after more than a year's trial can say that we are perfectly satisfied and that the St. George Hotel is one of best lighted hotels in the West.

We are Very Respectfully
Mackey & Huston

The United States Electric Lighting Co.

Address: C. C. WARREN, Manager Western Department 216 La Salle St. Chicago.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, SEPTEMBER 17, 1887. No. 12.

New Double Dynamo.

The McIntosh Galvanic & Faradic Battery company have recently made a small dynamo of half-horse power for medical and laboratory use Fig. 2 is a side view in section, and Fig. 1 a sectional end view at the commutator end.

In Fig. 2 the horseshoe field-magnet is shown at the right, its pole-pieces B, exterior and interior, projecting to the left and inclosing the ring armature C D. This armature is of the Gramme type, mounted on a spider, attached to the shaft at J. Its wrought-iron core, built up in a peculiar manner, is shown at C. It is compound wound in series, in two distinct circuits insulated from each other; the interior circuit, shown at upper D, is wound with coarse wire, and the exterior, shown at E, with fine wire. At F is a small commutator, connected with the interior circuit by an extension of the wire, shown at lower D, and at G is a large commutator connected with the exterior circuit. At H and H′ are the upper brushes, the lower ones not being shown. H is connected to an exterior yoke, and H′ to an interior yoke, as shown in Figs. 1 and 2. At I, I, is shown gearing, by which the brushes are changed by a rotary movement on the commutators, so as to vary the current in the usual manner.

The field-magnets are also wound in two separate circuits; the exterior coils of fine wire, shown at A, and the interior of coarse wire, shown at A′.

From the two separate circuits of this dynamo are obtained two separate currents; a current of great intensity and small quantity from the fine wire high resistance circuit for medical electrolysis, and a current of small intensity and large quantity from the coarse wire low resistance circuit for medical cautery. The range of E. M. F. is from one to 200 volts, and that of current from one to ten ampères. It is thus a double generator, to be used either for electrolytic or cautery purposes, or for both at the same time as required, and is intended, where power can be obtained, to supersede the battery. It will found especially valuable in hospitals and sanitariums, and also in college laboratories.

The Chicago Exposition.

September has come and with it the time-honored Chicago exposition for its stay of six weeks. The exposition was opened to the public September 2d and will be closed October 22d. Some of the exhibitors are late, but in the displays already made, the crowds of visitors find much to interest them. The attendance, by the way, is fully 15 per cent. in advance of that for the corresponding time last year. The character of the exposition does not permit much in the way of electrical exhibits, yet the Western Electric company, which has the contract for furnishing a large part of the electric lighting has a very attractive stand. Their plant consists of five 35-light arc dynamos. Three of these dynamos are run from one Buckeye engine, and are belted to one band wheel. Two of the machines are right and left hand, the pulleys nearly abutting, and parallel belts are run from the band wheel to the dynamo pulleys. Over one of the belts runs another belt, which is carried to the pulley of the third dynamo standing directly in rear of one of the pair of dynamos. On the opposite side of the booth is another pair of dynamos, which are belted to a Porter Mnfg. Co. engine. Superintendent Terhune is authority for the statement that the exposition has never been as well lighted as it is this year.

The Chicago Arc Light & Power Co., has about forty arc lights in the building. The company has calls for about as many lights as it can furnish with its present capacity, and would not agree to put in more than forty.

There is also a small incandescent light plant of the Tremont Electric Light company, which furnishes lights to a sewing machine booth.

Power throughout the building is furnished by a Corliss engine of 150 horse power, an Atlas engine of 150 horse power, and a Porter Mnfg. Co. engine of 50 horse power.

Ticker Quotations and the Law.

The case of William Cain against the Western Union Telegraph company, submitted to Judge Stone, of Cleveland, for a decision some time ago, and the motion on the part of the plaintiff that the defendant should show cause why it should not be attached for contempt of court, which was referred to Judge Noble, were both decided last week. The case grew out of an order from the Board of Trade of Chicago to the Western Union Telegraph company, instructing it to remove Cain's ticker, which reports the markets of the Chicago Board of Trade. A permanent injunction was sued for by Mr. Cain to restrain the telegraph company from removing the ticker. Judge Stone granted a temporary injunction July 23d, which was in force until August 4th, when it was mutually decided to extend it until the case should be finally decided. The order issued by the court was made known to the superintendent of the Western Union on the day that the temporary injunction was granted, but the order of the Board of Trade to the telegraph company was carried out, and the ticker removed. The superintendent ordered a person in the employ of the company to disconnect the wire, and so it has remained ever since. Such, in brief, is the history of the case, the termination of which has been looked forward to with interest.

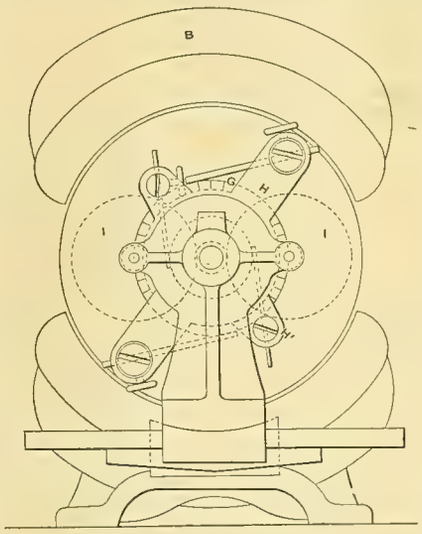


Fig 1.—New Double Dynamo.

The suit for the permanent injunction was decided in favor of the Western Union Telegraph company, by Judge Stone. He held that the company was not the proper defendant, but that the Chicago Board of Trade should have been the party to the suit. In his opinion, the Board of Trade has the right to deliver its markets to whoever it sees fit, and that the telegraph company merely transmits the messages. It is not bound to deliver to Mr. Cain private information which the Board of Trade sends to other parties, and not to the ticker man.

In the contempt of court case Judge Noble fined the Western Union company $100. He said that at the time the restraining order was issued the wire was connected, and, after it had been served the wire was severed; and no steps were taken to connect and restore it as it was at the time the order of the court was issued. Judge Noble said that in making the amount of the fine so low he was governed solely by his regard for the order made upon the full hearing by Judge Stone.

That Telephone Concession in China.

At the Chinese legation there was a conference last night, telegraphs James W. Stanley, a well-known eastern correspondent, from Washington, under date of the 6th, between the Mitkiewicz-Barker syndicate, the Chinese minister and the mandarins who accompanied Mitkiewicz to this country. This conference lasted until a very late hour, and the result was that a cablegram was sent to China to-day in which the names of the gentlemen who have subscribed for the stock of the syndicate were given. It seems that the amount of money to be subscribed has been overstated. It is $25,000,000 instead of $50,000,000. Of this sum twelve millions have been subscribed by the Chinese. One of the secretaries of the legation said to-day that the Chinese government would take five millions of the stock, and that the other seven millions have been subscribed for by merchants in the Chinese empire.

There was a number of men with more or less capital at their disposal at the Manning house to-day who were anxious to get in on the ground floor, but they were too late. It is said that Drexel, Morgan & Co. of Philadelphia, have agreed to take upwards of two millions of the stock which will be sold in the United States, and that every share is spoken for.

Chang Yen Hoon, the Chinese minister, is said to have been fully satisfied with the responsibility of the gentlemen who form the syndicate, and there is excellent authority for saying that the concessions were completed to-day by the addition of his signature to the papers which were brought from China by Mitkiewicz and his fellow-travelers. The amount at which the scheme is capitalized will seem rather small for the enterprises which are to be undertaken, but it is said by Mr. Barker's representative that the sum will be ample for the present, as the empire of China is not developed up to the point of gridironing the country as yet. Besides this, the cost of labor is so low in China that the work will be accomplished at an expenditure far less than similar enterprises would require in this country.

It seems that the concessions are really one concession. A bank is to be established with a capital of $25,000,000, and with the power to issue circulation up to the full par value of the stock. The charter of the bank carries with it the right to engage in telegraph and railroad construction.

While the financial record of Mitkiewicz in the United States may not have been always just what it should have been, the Chinese mandarins who accompany him seem to have the highest regard for his ability as a financier. They praise his shrewdness and consider him a sort of savior. They assert that his enterprise will be the making of the empire.

Tubular Boiler Tests.

We append an interesting and valuable report of tests made by the Woodbury Engine company of Rochester, N. Y., of a tubular boiler in the Edison Electric Illuminating company's station at the same place. The features are so fully set forth in the report that it is unnecessary to allude to them here, except to state, in addition, that the station has six boilers, and has chimney capacity for eight boilers. Only one boiler was fired as, if other boilers had been fired, the steam generated would have had to be blown off into the sewer.

The report is addressed to the Edison company and sets forth that the trials were made to determine

First: That each boiler was capable of evaporating, into practically dry steam, 5,000 pounds of water per hour for ten (10) consecutive hours, irrespective of coal consumption; and,

Second: The economic evaporation, when boilers were running at about their ordinary everyday work.

The trials are designated No. 1 and No. 2 respectively.

Test No. 1.

During this trial, which was in the daytime, but one engine was running, with the exception of about the last hour and a half; and as the engine used only one-half to two-thirds of the amount of water it was desired to evaporate, the surplus steam was blown into the atmosphere nearly the whole length of time occupied by the test.

The arrangement for weighing the feed water was by placing a barrel upon a platform scale, the scale being set high enough to allow the water to flow through a pipe and valve at bottom of barrel into a tank below, from which the suction to pump was taken. In starting, the depth of water in tank was noted, and at the end of test the water line in tank was brought to the same point. The barrel was filled each time with exactly 400 pounds of water, and the notation or credit of the water was made at the time each barrel was started to be emptied.

The height of water in gauge glass on boiler was noted in starting, and was carefully brought to the same level at end of test.

Every precaution was made to avoid losses by leakage through valves or connections. The safety valve on water discharge-pipe between pump and heaters, which leaked, was taken off, and the valve ground to seat so as to be tight. The 3″ valve, which shuts off the right-hand battery from feed-water pipe was disconnected, and a sheet iron blank placed between the flanges to prevent any possible leakage into the other boilers. The blow-off valve showed no signs of leakage, and the boiler itself was perfectly tight.

The coal was soft lump "Oak Ridge," and was weighed in a wheelbarrow, by setting the scales so as to balance with 300 lbs. of coal in wheelbarrow; and the notation or charge was made as each 300 pounds was dumped on the floor, with the exact time. As the conditions of this test were such that good economy could not be expected, the means of arriving at the amount of coal and combustible used were by starting and stopping the test with the fire in the same condition, and with the same amount of coal on the grates, as near as could be estimated. The ash pit was cleaned immediately after starting, also at the end of test, the ashes that had formed during the trial being weighed and deducted from total amount of coal for combustible. This has not the accuracy, in this respect, of the standard method employed in test No. 2, but was considered sufficiently exact for this one.

The temperature of feed-water was taken by a thermometer inserted in the delivery pipe, running across the front of boilers. Observations of the feed-water temperature, and steam pressure by gauge were taken, every fifteen minutes.

The feed-water was heated by the exhaust from engine in a National heater.

The setting of boiler, like all the others in the station, is with the Jarvis patent furnace, the outside walls being 17½″ thick and the division walls 22″ thick; height of bottom of boiler from grates is 30 inches.

The boiler has no dome. Steam is taken through a dry pipe located near top of shell, and 9 feet long. Dry pipe is 8″ diameter, and perforated at the top for about one-third of circumference. The grates are what is known as the "Tupper" grate, having air spaces ½″ wide.

Results of Test No. 1.

Date of trial		Aug. 8th, 1887
Duration of trial	hrs.	10,066
Kind of coal		"Oak Ridge" Bituminous

Dimensions and Proportions.

Diameter of shell	inches	66
Length of shell and tubes	feet	16
Number of tubes		92
External diameter of tubes	inches	3
Water-heating surface	sq. ft.	1345
Grate surface, 6 feet long, 5½ feet wide	sq. ft.	33
Ratio of water-heating to grate surface		40.75
Average steam pressure by gauge	lbs.	73.15

Average Temperatures.

Of fire room	deg.	95.6
Of steam	deg.	318.33
Of feed water	deg.	205

Fuel.

Total amount of coal consumed	lbs.	6116
Total amount of ashes	lbs.	355
Percentage of ashes	pr ct.	5.8
Total amount of combustible	lbs.	5761
Coal consumed per hour	lbs.	607.6
Combustible consumed per hour	lbs.	572.3

Water.

Total weight of water pumped into boiler and apparently evaporated	lbs.	48000
Equivalent water evaporated from and at 212 degrees Fahr. (48,000x1.041)	lbs,	49968
Equivalent water evaporated from and at 212 degrees Fahr. per hour	lbs.	4964

Economic Evaporation.

Water actually evaporated per pound of coal, from actual pressure and temperature	lbs.	7.85
Equivalent evaporation per pound of coal from and at 212 degrees Fahr.	lbs.	8.17
Equivalent evaporation per pound of combustible from and at 212 degrees Fahr.	lbs.	8 68

Rate of Combustion.

Coal burned per square foot of grate surface per hour	lbs.	18.41
Per square foot of heating surface	lbs.	.452

Rate of Evaporation.

Water evaporated from and at 212 degrees Fahr. per square foot of heating surface, per hour	lbs.	3.69
Water evaporated per hour from temperature of 100 degrees Fahr. into steam of 70 lbs. gauge pressure per square foot of grate surface	lbs.	130.8
Water evaporated per hour from temperature of 100 degrees Fahr. into steam of 70 pounds gauge pressure per square foot of heating surface	lbs.	3.21

Commercial Horse Power.

On basis of 30 pounds water per hour evaporated from temperature of 100 degrees Fahr. into steam of 70 pounds gauge pressure (or 34½ pounds from and at 212 degrees)		143.9

Calorimeter Trials.

For the experiments made to determine the quality of the steam, the barrel calorimeter was used. The barrel was set on a carefully tested platform scale, and in each experiment was filled with cold water to the amount of exactly 350 pounds. The temperature being taken, steam was then blown in through a pipe with hose at the end until about 116 degrees temperature was reached, when the water was again weighed and the temperature taken. The increase in weight represented the weight of steam added, and the increase in temperature measured the quantity of heat in the steam. A thermometer was used graded to fifths of a degree, and tenths of a degree could be read by careful observation. The pipe from which steam was taken was connected into the top of horizontal 5″ pipe near boiler.

Eight experiments were made during the trial, and each experiment has been calculated separately. The average value of the steam was 98.2; and it therefore contained 1.8 per cent. of moisture. This is practically dry steam, the contained moisture being small, especially when it is considered that the object and results of this test were a high evaporative capacity, and that if there was an excess of moisture at any time, it would be under these conditions.

The coal used was what was on hand at the station, and, as a few hours of firing proved, was unfit for the purpose of a test of this kind. The percentage of ashes is not high, and it works very well with moderate firing; but in burning the amount of coal per square foot of grate necessary to obtain a large quantity of evaporation, as was done in this test, the coal, after a few hours, partially melts on the grates, forming a thin clinker that covers over the air spaces and is very troublesome to remove. So troublesome did this become, that at about the end of the fourth hour it was absolutely necessary to clean the grates with the slice bar in order to go on at all. After much labor the grates were partially cleaned of the melted coal, but not entirely, and during the cleaning and the consequent loss of time in starting a fresh body of coal, the steam had to be partially shut off, and the evaporation fell behind. In this connection it will be interesting to compare the amounts pumped for each separate hour as given below. The amounts given are approximate, as the water level was not exactly the same at the end of each hour, and the corresponding time for emptying the barrel was not the same to a minute for each hour. The figures, however, are sufficiently accurate to show that the evaporative capacity of the boiler is much beyond the average of this test, with the proper kind of coal.

1st hour	6,400 lbs.
2nd "	6,000 "
3rd "	4,000 "
4th "	4,400 "
5th "	2,400 "
6th "	5,200 "
7th "	6,000 "
8th "	6,000 "
9th "	4,800 "
10th "	2,800 "

The load of engine was quite variable, making it extremely difficult to secure a uniform evaporation. The evaporation was reduced the third hour because it was running so far beyond what was desired, but the falling off of the fifth hour was on account of the melting of the coal. At about the commencement of the tenth hour the grates had again become in the same condition, but the test was finished without attempting more than a slight cleaning with slice-bar. Throwing out the last hour, the average evaporation per hour was 5,022 lbs. under observed conditions or 5,228 lbs from and at 212 degrees, corresponding to 151 horse power, on the basis of 30 lbs. per horse power evaporated from temperature of 100 degrees Fahr. into steam of 70 lbs. gauge pressure. Throwing out the 5th and 10th hours, the evaporation becomes for the eight hours an average of 5,350 lbs. per hour under observed conditions, or 5,569 lbs. per hour from and at 212 degrees, which is 161 horse power on the basis of rating as given above.

For the eight hours as above, the rate of evaporation from and at 212 degrees would be:

Per square foot of grate surface per hour	lbs.	168
Per square foot of heating surface per hour	lbs.	4.13

For the reasons stated, it can readily be seen that the latter evaporation represents more fairly than the ten-hour

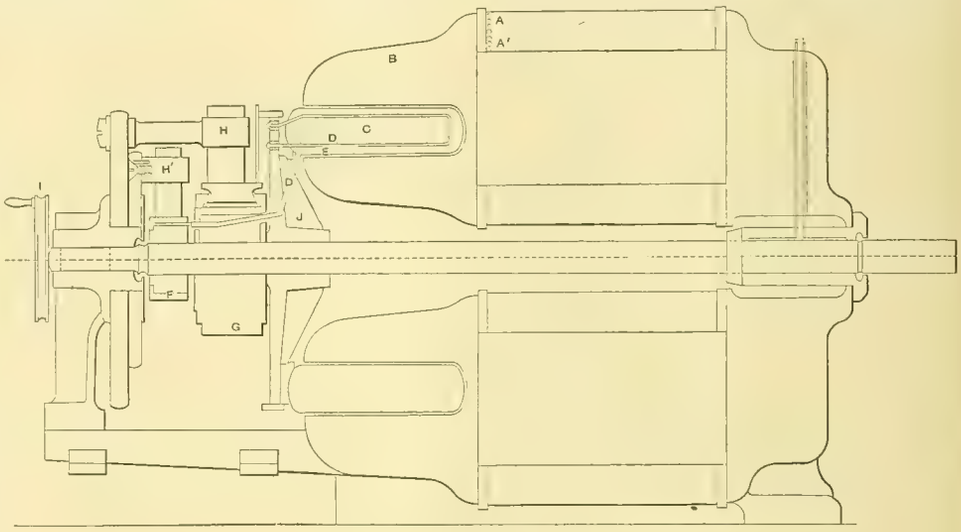


Fig. 2.—New Double Dynamo.

average what the boiler is capable of evaporating, with coal that will not melt on the grates under forced firing.

The synopsis of water fed, coal consumed and observed conditions are appended herewith, signed by the ones who kept the records and made the observations.

TEST NO. 2.

This trial, like No. 1, was in the daytime with but one engine running, and, for a short portion of the time, steam was blown into the atmosphere, so that the boiler was therefore doing somewhat more than its ordinary work. It was at first intended to make this trial on the same boiler, No. 5, as the previous test, but it would have consumed so much time to properly clean the clinkers from grates of No. 5 that No. 6, the boiler next adjoining, was fired up instead.

The arrangements for weighing the feed water were the same as employed on the day previous, and none of the pipe connections or other arrangements were disturbed.

The coal was the same kind as used for test No. 1, and some trouble was occasioned by clinkers, but nothing like that of the previous day. The coal was weighed in a wheelbarrow, and kept account of in the same way as before, but the manner of starting and ending was different. About two hours before starting the test, the boiler was fired and steam raised to 85 lbs. The fire was then hauled, the grates and ash-pit cleaned, and a new fire made as soon as possible from wood kindling and fresh coal. The test was started at the time of lighting the new fire, and at the end, the fire having been allowed to burn down rather low, it was hauled, and all unburnt coal and refuse on the grates were weighed, together with the ashes in pit. The steam pressure at end of test was nearly 85 lbs. as at the start.

This boiler is set with the Jarvis patent furnace, the same as all the others in station. It also has the "Tupper" grates; has no dome, but a dry pipe, and is in every way a duplicate of No. 5 boiler, and of all the others in the station. The feed water temperature and steam pressure observations were taken every 15 minutes. The moisture in the coal, as ascertained from a sample dried out, was about 1 per cent.

RESULTS OF TEST NO. 2.

Date of trial		August 9th, 1887
Duration of trial	hrs.	10.05
Kind of coal		"Oak Ridge" bituminous

DIMENSIONS AND PROPORTIONS.

Diameter of shell	inches	66
Length of shell and tubes	feet	16
Number of tubes		92
External diameter of tubes	inches	3
Water-heating surface	sq. ft.	1,345
Grate surface, 6 ft. long, 5½ ft. wide	sq. ft.	33
Ratio of water-heating to grate surface		40.75
Average steam pressure, by gauge	lbs.	79.02

AVERAGE TEMPERATURES.

Of fire-room	deg.	97.8
Of steam	deg.	322.9
Of feed water	deg.	205.1

FUEL.

Total weight of coal consumed	lbs.	4,403
Weight of wood for kindling 74 lbs., value .4 of coal	lbs.	30
Weight of coal, including wood equivalent	lbs.	4,433
Total weight of ashes and clinkers	lbs.	388
Percentage of ashes and clinkers	pr. ct.	8.7
Total weight of combustible	lbs.	4,045
Coal consumed per hour	lbs.	441.1
Combustible consumed per hour	lbs.	402.5

WATER.

Total weight of water pumped into boiler and apparently evaporated	lbs.	40053
Equivalent water evaporated from and at 212 degrees Fahr. (40053x1.042)	lbs.	41735
Equivalent evaporation from and at 212 degrees Fahr. per hour	lbs.	4153

ECONOMIC EVAPORATION.

Water actually evaporated per pound of coal, from actual pressure and temperature	lbs.	9 01
Equivalent evaporation per pound of coal, from and at 212 degrees Fahr.	lbs.	9 39
Equivalent evaporation per pound of combustible, from and at 212 degrees Fahr	lbs.	10.32

RATE OF COMBUSTION.

Coal burned per square foot of grate surface per hour	lbs.	13.46
Per square foot of heating surface	lbs.	.33

RATE OF EVAPORATION.

Water evaporated from and at 212 degrees Fahr. per square foot of heating surface per hour	lbs.	3.09
Water evaporated per hour from temperature of 100 degrees Fahr. into steam of 70 lbs. gauge pressure per square foot grate surface	lbs.	109.4
Water evaporated per hour from temperature of 100 degrees Fahr. into steam of 70 lbs. gauge pressure per square foot heating surface	lbs.	2.69

COMMERCIAL HORSE POWER.

On basis of 30 lbs. water per hour evaporated from temperature of 100 degrees Fahr. into steam of 70 lbs. gauge pressure (or 34½ lbs. from and at 212 degrees)		120.5

No calorimeter trials were made on this boiler, but it is fair to assume that the steam was of the same quality as on the day before, viz: 98.2 per cent and 1.8 per cent. of moisture. If any difference existed, there should be less moisture in this test, as the average evaporation per hour was about 20 per cent. less than in No. 1 test the day previous.

SYNOPSES OF OBSERVED CONDITIONS.

DIMENSIONS OF BOILER: 66 inches diameter, with 92 tubes, 3 inches diameter, 16 feet long.

Designation of Boiler, No. 5.	
Date of test	Aug. 8th, 1887.
Duration of test	10 hrs. 4 min.
Average temperature of feed water	205 deg.
Average steam pressure by gauge	73.15 lbs.
Total water fed to boiler and evaporated under observed conditions	48,000 lbs.
Total amount of coal consumed	6,116 lbs.
Total amount of ashes	355 lsq.

DIMENSIONS OF BOILER: 66 inches diameter, with 92 tubes, 3 inches diameter, 16 feet long.

Designation of Boiler, No. 6.	
Date of test	Aug. 9th, 1887.
Duration of test	10 hrs. 3 min.
Average temperature of feed water	205.1 deg.
Average steam pressure by gauge	79.02 lbs.
Total amount of water fed to boiler and evaporated under observed conditions	40,053 lbs.
Total amount of coal consumed	4,403 lbs.
Wood for kindling	74 lbs.
Total amount of refuse and ashes	388 lbs.

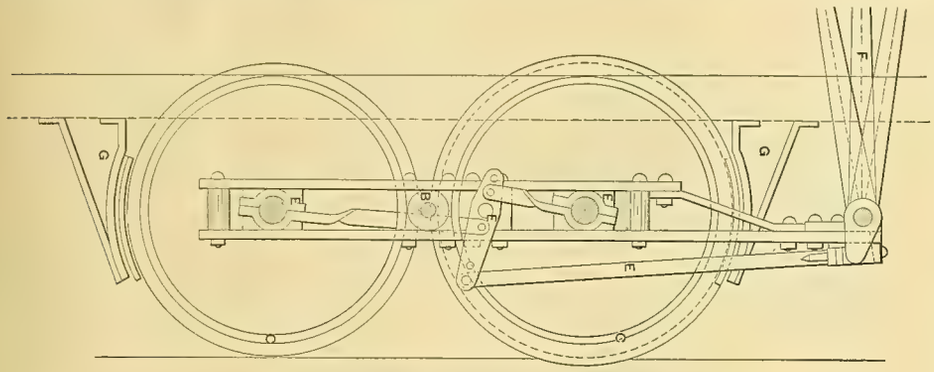


FIG. 1.—WEIS MOTOR ARRANGEMENT.

The Weis Motor Arrangement.

Last week a New York correspondent describes in these columns a trip over the Jersey City & Bergen horse railroad in a car propelled by an electric motor which had the current furnished it by a storage battery. The mechanical arrangement of the motor and gearing was that of Mr. Weis, a train dispatcher in the employ of the Pennsylvania railroad company. We publish sketches in connection which will give a clear idea of the arrangement devised by Mr. Weis. Fig. 1 represents a vertical section and Fig. 2 a horizontal section. A, represents the motor; B, the friction wheels; C, the friction wheels on car wheels; D, the gear wheels; E, the arrangement for starting and braking; F shows the reverse lever and G, the stationary brake.

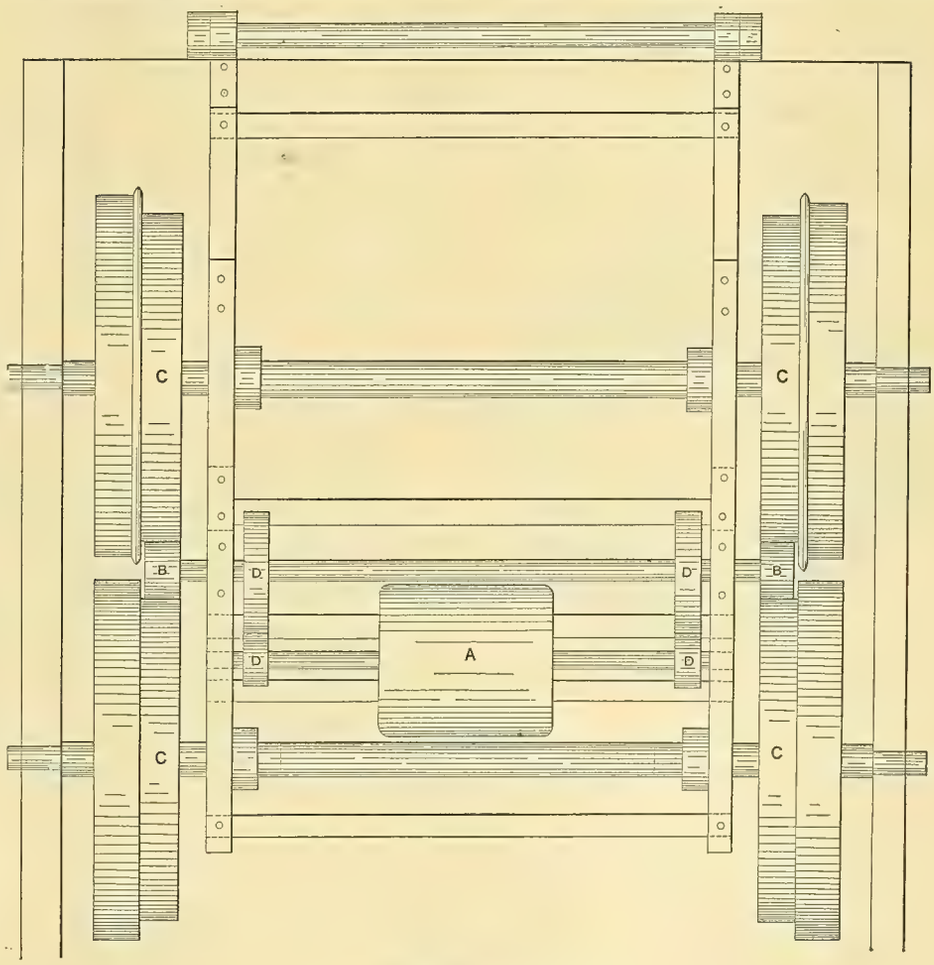


FIG. 2.—WEIS MOTOR ARRANGEMENT.

Electrical science is enriching the language in a jawbreaking manner. "Telegastograph" is the latest contribution.

The outcome of the conference between telephone cable users and manufacturers held in New York on the 7th, was that metallic circuits should be used.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

NUMBER X.

The Brush Dynamo.—The distinctive features of the well-known Brush dynamo are of sufficient importance to demand a brief notice in these articles. These relate chiefly to the construction of the armature and commutator. The armature core, shown at X, Fig. 24, has a central ring, B, B, B, composed of layers of thin sheet iron ribbon, insulated by vulcanized fibre. These are separated from each other by short iron pieces, one of which is shown at Y; the central part of each having the same width as the ring, while at each end are projections on opposite sides, forming, when placed in the core, the V-shaped figures shown at X; the arrangement, when the core is bolted together, being shown in cross-section at Z. The ends of these pieces are separated slightly in the interior, and more widely at intervals in the exterior, as shown in Fig. 25. The core is bolted to an interior rim, shown in Fig. 25, which is attached at four opposite points, to a spider mounted on the shaft.

This open, laminated structure affords ventilation, eliminates the Foucault currents, and gives, in the central portion, between the projections, a solid support for the coils. The old style core, which resembles this, was of cast-iron, deeply channelled for ventilation, in the center and in each projection, but was abandoned on account of the Foucault currents and consequent heating, notwithstanding the excellent ventilation. The new core gives the dynamo an increase of more than 40 per cent in efficiency.

The coils are wound with insulated copper wire between the projections, as shown in Fig. 25, and supported, on the exterior and interior portions of the core, by projecting flanges The winding is of the open circuit type described in No. I of this series, the coils being arranged in pairs on opposite sides of the armature, each pair forming a complete, independent circuit, the two ends of the wire being attached to opposite segments of the commutator; an eight-coil armature having four circuits and eight commutator segments, as shown in Fig. 26, in which the connections with

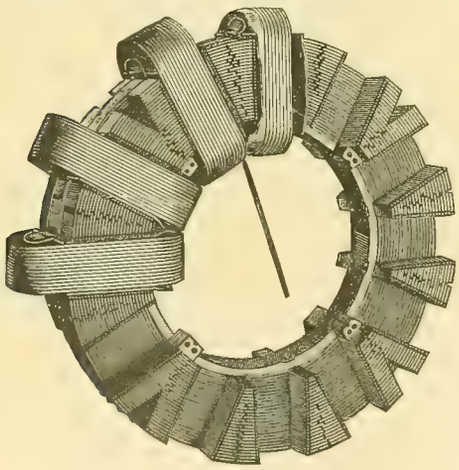


Fig 25.

the commutator are represented, that part of the wire connecting each pair of coils being omitted.

The construction of the commutator and its connection with the coils will be understood by comparing Fig. 26, showing the connection, with Fig. 27 in which it is shown in perspective. It consists of two cylinders, as shown, each having an equal number of segments; an eight-part commutator, being composed of two four-part cylinders mounted on the same shaft, in such a position that the segments on one cylinder are about one eighth of a circumference in advance of those on the other; the narrow end of each T-shaped segment of one cylinder being placed opposite the broad end of each similar segment of the other. In the latest style the narrow part of the segment is cut off and replaced by a block of lignum vitæ, which has a copper strip on one edge to prevent wear from the brush contacts; so that each four-part cylinder has, at each end, two segments placed as shown, with narrow blocks between. The segments are of copper, separated by air spaces, and screwed to segments of brass mounted on two concentric interior cylinders, one of vulcanized fibre, immediately under the brass segments, and the other, which is attached to the shaft, of lignum vitæ.

It will be seen from Fig. 27 that while the brushes, A A′ are each in contact with a single commutator segment, the brushes B B,′ are each in contact with two segments, and by comparing this with Fig. 26, it is seen that A A′ are thus connected with coils 3, 3, while B B′ are connected with coils 2, 2, and 4, 4; coils 1, 1, being disconnected. B B′ are therefore connected in

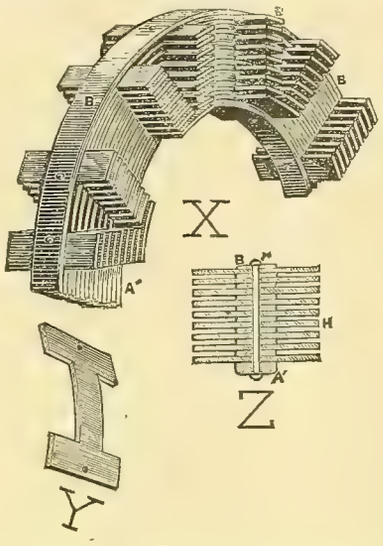


Fig. 24.

parallel with two pairs of coils but not with two adjacent pairs; coils 3, 3, lying between them. Six of the eight coils are thus brought into action at once, and this represents the relative positions of the various parts constantly during rotation. Coils 3, 3, are in the line of greatest variation of magnetic intensity and consequently of best action, and are joined, through the external circuit, by the brushes A A′; coils 4, 4, approaching this position, and coils 2, 2, leaving it, are joined in parallel by the brushes B, B′; while coils 1, 1, being in the line of least variation of magnetic intensity, and consequently of least action, are disconnected. The current from the external circuit entering at A and traversing coils 3, 3, leaves at A,′ thence returns through the external circuit to B, and traverses coils 2, 2, and 4, 4, leaving by the external circuit at B,′ and thence returns again to A, completing the circuit. It is thus seen that the positive current is from coils 3, 3, where the electric potential is highest, to coils 2, 2, and 4, 4 of lower potential, from their position, and of less resistance from being joined in parallel, and thence negatively back to 3, 3.

It is evident that such an armature may be composed of any even number of coils, arranged as described. The armature of the largest brush dynamo, shown in Fig. 25, has sixteen coils. The copper segments of the commutator are attached with screws, and easily removed for repairs or renewal.

Two styles of the Brush dynamo are now made, one for arc lighting, series-wound as formerly, and the other shunt-wound for incandescent lighting. The automatic, rotary movement of the brushes on the commutator, already referred to has been recently adopted, and is used in both machines. The arc-light machine is shown in Fig. 28. The field-magnets, which are of the horse-shoe type, are placed on opposite sides of the armature, as shown. Those of the arc light dynamo are wound with large wire, and have also an interior fine wire used as a shunt in regulating the lamps. The magnets of the shunt-wound dynamo have large wire next the pole-pieces, and fine wire next the magnet yokes. It will be noticed that the planes of the armature coils are at right angles to the plane of rotation, and cut the lines of force in a different manner from any of the dynamos thus far described; and that the core projections, coming close to the pole pieces, lead the magnetism through the coils

Electrical Distribution by Alternating Currents and Transformers.

Part II.

After describing a few more of the latest forms of transformers, he concludes his history by saying "the introduction of this system in America has created a somewhat amusing flutter among the electrical fraternity." We agree with him, and recall here a statement made in the *Franklin Institute Journal* some time ago, regarding these systems: "It is not very creditable to the Americans to bring before the public as new, a system which has been known and used in Europe for a number of years past."

He concludes his interesting articles with rules of construction, among which are the following: "To be self-regulating for supplying a constant potential and varying quantities of current, the transformers should have the primary coils connected in a multiple arc system in which the mains have a constant potential. The lengths of wires must be found for self-regulation according to the laws:

(1.) When no work is being done in the secondary circuit there should be no current in the primary circuit; that is, the counter pressure in the primary must be equal to the primary pressure, or very nearly equal thereto.

(2.) As the current increases in the secondary circuit, the current in the primary should increase proportionally in the ratio of the transformer; that is, the counter pressure in the primary should fall as work is increased in the secondary.

"All transformers working in one system must be constructed accurately with a fixed ratio."

Rule 1.—To find the lengths of the primary and secondary conductors in a transformer for reducing from a high to a low pressure, divide the primary pressure by the coefficient of induction in the primary circuit (that is, by the induction in volts per foot of wire), this will give the length in feet of wire for primary.

Rule 2.—Divide the secondary pressure by the coefficient of induction in volts per foot, this will give length in feet of wire for secondary.

In the best transformers working with about 200 alternations per second this coefficient is very high and averages about two volts per foot, and that may be taken as the figure for use in the above rules; for example:

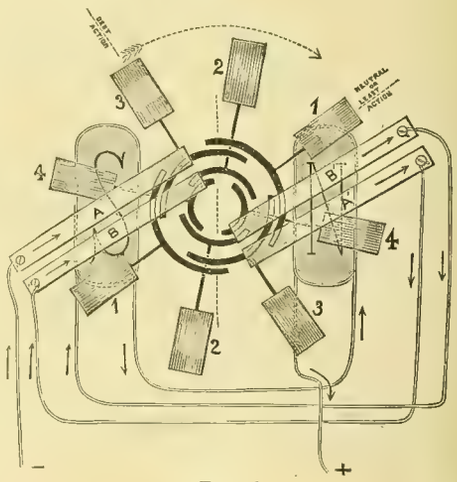


Fig. 26.

Given a primary pressure of 1,200 volts, and the required secondary pressure given as 80 volts, what lengths of primary and secondary wire should be employed?

Answer, $\frac{1,200}{2}=600$ feet for primary,

$\frac{80}{2}=40$ feet for secondary.

These lengths do not include wire not under induction.

If the alternations are not so rapid this coefficient becomes less. It might be argued from this fact that as it is perfectly easy to make the alternations very much more rapid than 200 per second, that, say 500 or 1,000 alternations should be adopted. There is a limit to that; as the alternations increase in number per minute the losses in the transformer increase, and that fact

often accounts for different efficiencies being found for the same transformer by different experimenters—the one, perhaps, has employed the alternations for which the transformer was calculated, the other has employed slower alternations and therefore no agreement could be come to. It is, therefore, necessary to ascertain by experiment the coefficient of induction for each type of transformer at a given alternation rate. In transformers with long magnetic circuits, common to all the coils of wire, the coefficient will not be higher than 1.5, and often falls as low as one foot per volt.

Practically this coefficient may be found by taking the given alternating pressure having the given rate of alternations through an approximately correct length of primary wire on the transformer, say a length calculated at two volts per foot (the secondary circuit being open or not yet wound on), and measuring the current produced through this length. If no measurable current is observable then that is the correct length; there should be some current, of course, say, perhaps, two per cent. of the maximum current. If the coefficient of induction is less than that calculated upon a considerable current passes in the primary when no secondary current is flowing. The primary wire must, in that case, be increased in length until this initial current disappears, or becomes so small that it is of no account, and then the length of secondary can be calculated by the rule.

Rule 3.—The ratio of a transformer is found by dividing the primary pressure by the secondary pressure, thus in my previous example:

$$\frac{1,200}{80}=15.$$

15 would be said to be the ratio of that transformer, and thus

	Primary.		Secondary.
The pressures are to each other as	15	to	1
The lengths of conductors to each other as	15	to	1
The cross-section of conductors to each other as	1	to	15
The currents to each other as	1	to	15

The iron conductor of magnetic force should not at any time be anywhere near half saturation; it should therefore have large cross sections, and data for calculating its size may be obtained from dynamo builders."

In another article on induction coils, by Gisbert Kapp, in *Industries*, reprinted in the London *Electrical Review*, April 22 and 29, 1887, pages 366 and 390, the writer makes the following statements:

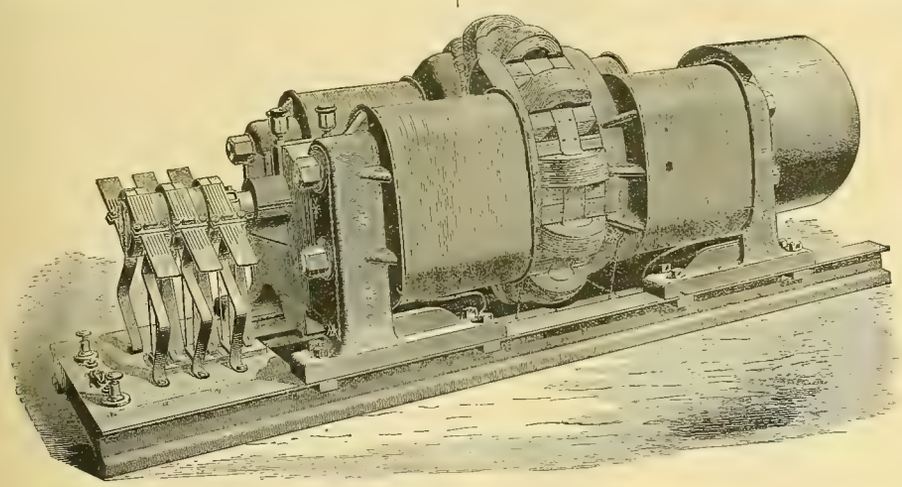


Fig. 28.

"A person having no theoretical acquaintance with the behavior of alternating currents, would compute the rate of doing work" (*i. e.*, the power) "in the circuit by simply measuring the current (say, with a Siemens dynamometer), and the terminal pressure of the machine (say, with a Cardew's voltmeter), and multiply the two. The product he would, generalizing from his experience with continuous current machines, consider equal to the rate of doing work, but this would be completely wrong, because he would have neglected the time element."

"A ring-shaped inductor, wound in the Gramme fashion, that is, with the iron inside and the copper outside" (*i. e.*, Faraday's form), "will not be as economical in weight of materials used as the inverse arrangement of copper coils inside and iron wire wound over them to form the outside" (*i. e.*, Zipernowski and Déri, or Staite form).

He shows from theoretical deductions that transformers connected in series cannot be made self-regulating for giving a constant potential in the secondary, unless approximately when the amount of iron is small and over-saturated. That such a transformer may have its secondary coil short-circuited without the current in it becoming

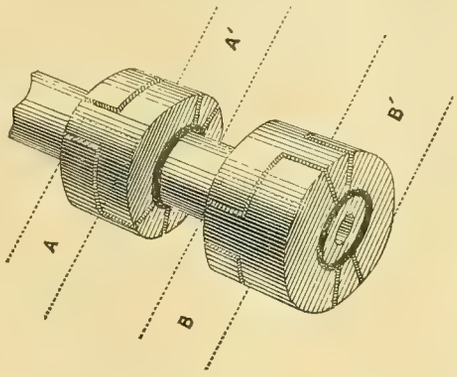


Fig. 27.

very great. That the characteristics of transformers in parallel is a straight line, and that it therefore is perfectly self-regulating for constant potential.

(*Concluded.*)

Instances of Photography by Lightning.

One of the handsomest and most popular belles of Lincoln, Neb., was a few days ago the owner of a little pug dog. During a recent storm, the dog was frightened by the noise of the elements, and took refuge in the bedchamber of his mistress. She happened to be engaged in changing her dress at the moment, but, noticing the extreme agitation of the little pug, she took him in her arms to reassure and comfort him. At that instant a loud dash of rain attracted her attention, and she drew the curtain aside to peep out. Just then came a blinding flash of lightning, and the young lady fell to the floor, stunned and unconscious. Other inmates of the house, hearing the fall, came in and found her. The little dog was killed by the shock, and it was hours before the young lady recovered animation. When she did so she was horrified to find that an image of her dog, life size, had been photographed on her bosom. There seems to be no way of removing the picture, which gives every shade, color and wrinkle of the canine form.

A heavy storm passed over Fayette township, Mich., one evening not long ago. While it was in progress Amos J. Biggs, a farmer, went into his back yard to frighten away some fighting cats. So intent were they on exterminating one another as to allow Farmer Biggs to approach within a few feet of them. At the same instant there was a crash, and an electric discharge struck a wood-pile, scattering it, and stiffened the cats in an intense rigor mortis.

Aside from a prickly sensation and sudden but not severe contraction of the muscles, Mr. Biggs experienced no unpleasant effects. When he returned to the house his wife took one look at him and fainted. On recovering she exclaimed: "Oh, Amos, the devil has set his mark on you!" whereupon Biggs looked in the glass and saw the image of a cat photographed in silhouette upon his broad forehead. All efforts to wash it off were unavailing.

Electric Lighting of New York.

The gas commission of New York, consisting of the mayor, comptroller, and commissioner of public works, have divided the lighting of the city between the following companies:

United States Illuminating company—Washington Park, 15 lights at 24 cents; and Cortlandt, Liberty, Barclay and Whitehall streets, and Chambers street from Broadway to East River, 38 lights at 40 cents.

Brush Electric Illuminating company—Avenue A, from Fourteenth street to Twenty-fourth street; First avenue, from Fourteenth to Fifty-ninth street; Grand street, from Broadway to Sullivan street and Union and Madison Squares, 91 lights at 25 cents; also Irving place, from Fourteenth street to Twentieth street; Fourth avenue, from Fourteenth street to Seventeenth street, and Eighth street, from Third avenue to East River, 23 lights at 40 cents.

American Electric Manufacturing company—Sixth avenue, from One Hundred and Tenth street to One Hundred and Thirty-sixth street; One Hundred and Tenth street, from Boulevard to St. Nicholas avenue; Boulevard, from One Hundred and Tenth to One Hundred and Fifty-fifth street; total, 93 lights, at 32 cents; also Third avenue, from the bridge to Willis avenue, and One Hundred and Thirty-eighth street, from Third avenue to Madison avenue bridge; total, 26 lights, at 40 cents.

East River Electric Light company—Park row, the Bowery, Third avenue to Eighty-sixth street; Grand street, from Broadway to East River; Sixth avenue, from Carmine street to Fifty-ninth street; Eighth avenue, from Fourteenth street to Fifty-ninth street; Broadway, from Canal street to Fourteenth street, 244 lights at 19 9-10 cents; also Tenth avenue, from Fourteenth street to Fifty-ninth street; Centre street, from Grand street to the Bridge; Desbrosses street, from West street to Canal street; Christopher street, from Sixth avenue to West Street; Houston street from river to river; Tenth street, from Second avenue to East River; Eighth street, from Sixth avenue to Cooper Union; Fourth avenue, from Bowery to Fourteenth street; First avenue and Avenues B and D, from Houston to Fourteenth street; West Broadway and South Fifth avenue; Stuyvesant street, from Eighth street to Tenth street, 191 lights at 39 cents.

Mount Morris Electric Light company—Greenwich street, from Battery place to Warren street, 15 lights at 40 cents.

Harlem Lighting company—One Hundred and Twenty-fifth street, from river to river; Eighth avenue from One Hundred and Twenty-first street to One Hundred and Fifty-fifth street; Third avenue, from Eighty-sixth street to One Hundred and Thirtieth street, 116 lights at 24 cents; Mount Morris Park, 12 lights at 50 cents, and Harlem Bridge (Third avenue) 7 lights at 60 cents.

A Large Storage Battery.

What is said to be the largest battery of accumulators now at work in France is that at the Hotel de Ville in Paris. The old form of Planté cells with spiral plates has been chosen. The active surface of each plate is about 52 square feet, and the storage capacity has been increased on Planté's principle by pickling in nitric acid. Each cell is capable of giving a current of 240 ampères, which, at the average pressure of 1.9 volts, represents a discharge at the rate of .6 horse power. Since there are 165 cells the total energy is about 100 horse power. These batteries were made by Reynier, and have a total weight of 11 tons. Current is supplied by three Gramme dynamos driven from portable engines in an annexed building.

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AT the present writing the Baltimore & Ohio telegraph system has not passed into the hands of the Western Union Telegraph company. The daily papers have published columns on the reported transfer of the system to its great rival, and rumors to the same effect have been used by judicious stockbrokers to their financial advantage. These are the weightiest announcements that can be made at the moment.

THE article on "Electrical distribution by alternating currents and transformers," which we conclude in this issue, has a practical value at this time, when alternate current dynamos for electric lighting are coming into use in this country. The first part of the article, which appeared in our last issue, was chiefly devoted to the history of transformers, and the claims of various inventors, while in the second part, given in this issue, will be found practical rules, principles and experimental deductions of the highest value.

IT is undoubtedly a fact that considerable progress is being made in this country in the use of electric motors, both for tramways and for furnishing small power in factories. There has been a superabundance of smoke about the matter of making and introducing electric motors and engines, and we are glad that there has been some fire.—*American Machinist.*

Motor manufacturers whose books are burdened with unfilled orders, will appreciate the kindness that dictated the sentiment of the foregoing, but really the less smoke and fire there is about a motor the better the electrician is pleased

THE English government have decided to promote a bill at the next session of parliament which shall place all theaters throughout the United Kingdom under the supervision of a special government department, regular inspections of their conditions being made by competent architects. The expense of the new department will probably be met by a special tax to be levied on all theaters and music halls.

In view of the recent holocaust at the Exeter theater, the bill should be passed, and like measures for the safety of audiences in American theaters should be taken. Objections on the ground of economy will doubtless be raised by managers of places of amusement, but paramount to all objections is the safety of human beings who, looking for recreation and amusement, virtually hold their lives in their hands in many death-traps dignified by the name of theater or place of amusement.

OLD residents of Chicago, passing the northeast corner of Franklin and Washington streets, are surprised to see a magnificent granite building rising on ground for many years devoted to cheap sheds for the manufacture of cheap furniture. This building is to be the home of the Chicago Telephone company, and its massive proportions fitly represent the capital and enterprise of the company, and will prove a valuable addition to that long deserted locality.

The writer recalls the fact that fifty-three years ago, when Chicago was an Indian trading post of 500 inhabitants, and the old wooden stockade known as Fort Dearborn, with its garrison guarded the harbor entrance, he stood on that ground and looked out over the vast prairie now covered by the great city. Two weeks, by the lakes, Erie canal and Hudson river, was then the shortest time of communication with New York, and the prediction that in fifty years a man could talk at the end of a wire and be heard distinctly in New York would have been deemed a greater fable than any in the "Arabian Nights." But the then wildest dream of the wildest dreamer is the accomplished reality of to-day, as attested by the rise of this stately monument to scientific development.

WE continue in this issue Dr. Wietlisbach's article on the theory of telephone conductors. The subject is one of great practical importance, and the doctor's close, analytical examination of the physical conditions on which telephonic transmission depends shows deep investigation into the subject, while his mathematical formulæ, demonstrations and rules are of great importance in determining values and establishing principles.

While the telephone is justly entitled to precedence as one of the most wonderful achievments of science, it cannot be denied that it is still a very imperfect instrument; and if self-induction and other faults, which at present impair its usefulness, are to be eliminated, it must be done by just such a course of investigation as Dr. Wietlisbach is pursuing. The skill which develops and renders practical any great invention is of equal value with that which originally produced it.

The discussion of the principles of long distance telephony, given in the last part of the doctor's article, is highly interesting and full of suggestions.

OUR New York correspondent briefly but happily described last week the climax in a new drama, "The Still Alarm," by Joseph Arthur, brought out at the Fourteenth street theater in New York. The "old timers"—and they are far from old men—can readily recall the days when he who discovered a fire raised the alarm by a yell which was in turn passed along by stentorian lungs until it reached the vicinity of the house of "Red Rover No. 3," or "Big Six" or some other company of equally fanciful appellation. Then the old hand engine came out, and there was a race for the scene of the fire. The brakes were manned and backs were bent to the work of sending a stream of larger diameter and to a greater distance than a rival company. But the development of the steam engine, the fire alarm telegraph, the mercurial fire alarm and the steadily advancing improvements in fire departments, have wrought a great change. Few of the generation of to-day are familiar with the workings of a city fire department save through the pictures painted in lead types of newspapers. The transference of the scenes of a fire engine house to the stage is no small feat, and the rapid transformation of the stage into a scene of the activity of a fire department house at the moment of an alarm, is a still greater feat. Undoubtedly the drama—though probably of the sensational type—will for a time at least draw crowds who are interested in the *modus operandi* of a fire department.

THE numerous instances of the photographic effects of lightning noticed from time to time in the public prints, two of which we give in another column, leave no doubt as to the genuineness of the facts, though many of the attendant circumstances and results are evidently supplied by the imagination. The phenomenon is very simple and easily explained. The requisites are a sensitive surface, an intensely brilliant flash, and an object so placed as to screen that portion of the surface covered by its shadow from the effects of the flash. The image is outlined on this space, and when produced by converging rays would evidently be smaller than the object, the size depending on the convergence.

It may be an electric effect, or merely a photographic effect. In Crooke's high vaccuum tubes the image of a selenium cross is produced on the broad end of a tube in a similar manner, a charge of electricity is sent through the tube, and the glass is shielded from its effects by the inductive influence of the metal cross, as maintained by the writer, or from electric bombardment by radiant matter, as maintained by Crooke. If the effect of the flash is such as to discolor the surrounding surface an image of the object must evidently remain on the surface protected by it. This is undoubtedly what happened in the case of the young lady; the dog received the full effect of the lightning and was killed, while its young mistress, protected by the dog's body over the vital part, had the surrounding surface discolored, leaving on her breast the image of her protector. In the other case the cats were evidently on top of the wood-pile, and one of them in line between the farmer's forehead and the course of the discharge, and his life was saved by the sacrifice of that of the cat.

Similar cases are on record where the object has been outlined on a wall opposite a window. In all such cases it is an open question whether the effect is electric, photographic, or a combination of both.

"SEVERAL failures of air brakes recently emphasize the fact that the best safety devices must have some attention if it is expected that they will work satisfactorily. Neglect to properly handle the brakes appears to have caused all the trouble there was in all these cases. There is in human nature a common weakness in the direction of supposing that a particularly good thing in the mechanical line ought to take care of itself. The air brake mechanism that is neglected fails to work some day, no matter how nearly perfect it was originally; the boiler that is made of the best material and in the best manner, it is sometimes apparently thought ought to take care of itself indefinitely, but it fails mysteriously. The best steam engine is the one that is most persistently neglected; the modern safety valve is so immeasurably superior to the ancient kindred device that it is presumed it should keep itself in condition through months of inactivity, and so on with a hundred things. Sometimes it is honestly argued that the rudest primitive arrangement is the best, or at least the safest, because it will not be assumed that it will do anything without help. But this argument simply resolves itself into one for a little care of the thing that is good in itself. Modern machine tools, for example, can be made to do much more work than those of the thirty years ago, but no one would argue that the old ones were the best, because, if kept in bad condition, the new ones would do more poor work than the old ones."

There is a nugget of solid wisdom in these remarks made by the *American Machinist.* An automatic device too often fails to accomplish its purpose for the very reason that it bears the name of being automatic in its workings irrespective of the fact that a self-working apparatus needs attention at times as much as a primitive device dependent for operation on the one in attendance. Again, the essential purpose of such a device is defeated through ignorance. In illustration: In a large steam plant a low and high water alarm which sounded signals of danger by whistles was attached to a boiler at cost of about fifty dollars. It was automatic and peformed its duty to the letter of the guarantee. Three weeks after it had been put in service it was not working, and an investigation showed that the whistles had been plugged. The engineer was asked the reason, and the reply was that the blanked "thing was whistling all the time and he could not stand the noise." The company for which this engineer worked had not been apprised of the outcome of their investment in the automatic alarm up to a recent date. Active inventors have wrought a legion of automatic devices, too many of which have been condemned and discarded solely through lack of care and ignorance. It is safe to say that out of this legion there are few that will never fail to work. Ninety

hundred and ninety-nine times they do their duty, but the thousandth time they fail, may be for the slightest of causes that might have been avoided if they had only received a little attention.

The mercurial fire alarm in principle is a fair illustration of an automatic device that under almost any conditions will work and carry out the intention embodied in its construction. But it is dependent upon the battery being in working order and upon the circuits being ready to perform their duty when called upon. For several days on an annunciator outside a large building in Chicago, one of the pointers—a mute witness to the neglect of some one—has indicated the existence of a fire where there is no fire, or, in other words, one of the circuits is out of order, and in obedience to the governing law of its construction the pointer has indicated a danger that at the moment does not exist. A fire in reality, under the conditions, would not be indicated, and if a fire should occur, the whole system undoubtedly would be condemned as faulty because it failed in the crisis, while the reason of the failure would rest not with the system but with the careless man whose business it was to see that conditions which interfered with the working of the system were removed. Automatic devices are to be encouraged. But it is sometimes a question whether it would not have been better if the Greek had not invented the word automaton or the English transferred it bodily to its language and adopted its derivatives for the reason that so much dependence is placed upon any appliance characterized as automatic and upon that account neglected.

The Theory of Telephone Conductors.

BY DR. V. WIETLISBACH IN ELEKTROTECHNISCHE RUNDSCHAU.

PART II.

The peculiar thing about this is the circumstance that deep tones are weakened relatively less than high tones. A change in the relative intensity of the separate partial tones would therefore be caused, by which the voice would be more or less mutilated. This influence grows with the product CW, and I have found that CW =500, is the final limit to which one can go in exchange plants without injuring the distinctness of transmission. This value has been regarded as too small on many hands, but no case has come to my knowledge where cables, free from induction, are in use in a telephone system, in which CW goes beyond 300. If we exclude exchange plants with double wires, of which we shall speak later on, the greatest cable lengths are in use in Copenhagen. In that telephone system, there are employed about 30 kms. of Felten & Guilleaume anti-induction cables. The greatest distance through which speech is carried on is about 10 kms., and for this distance CW is about 300. Thus intelligible speech is possible over this length of cable, but the mutilation of words is very perceptible. In order to improve transmission, the electro-magnets of the bells have been provided with shunt circuits, and various other aids have been brought into use, which are not necessary in a telephone system. This leads me to conclude that the limit set down by me is rather too great than too small, but I do not by any means contend that under favorable circumstances, intelligible speech is not possible over considerably greater stretches of cable. Thus Messrs. Felten & Guilleaume told me that Mr. Oesterreich, in Berlin, has succeeded in talking through 25 kms. of cable. Such experiments are very instructive, but are of no practical value, because that very essential element for their success, the personal equation of the experimenter cannot be counted on in general service.

I lay especial stress on the fact that all of my considerations hitherto are correct only if the influence of insulation is not brought into play. They are correct, for cables manufactured in Europe, as their insulation is usually 1,000 megohms, or even higher. But in America cables are manufactured whose insulation sinks to less than 10 megohms per km. With these the influence of lack of insulation or the loss of current must be taken into account. If W is the insulation, and we call $W \mid W_1 = h$, then the current which comes to the end of the cable is

$$\text{II.}\quad i = \frac{A}{W}\sqrt{\alpha^2+\beta^2}\,\frac{2}{\sqrt{[e^{2\alpha}+e^{-2\alpha}-2\cos 2\beta]}}\cos(2\pi n\,t+\delta);$$

$$\text{where } \alpha = \sqrt{\frac{h+\sqrt{h^2+2\pi n CW}}{2}};$$

$$\beta = \sqrt{\frac{-h+\sqrt{h^2+2\pi n CW}}{2}}.$$

It is easy to see that loss of current vitiates transmission. As an interesting instance of this I refer to the 500 wire cable which was laid last autumn in Chicago. The capacity of every wire was .2 mf. and the resistance 8 ohms for one km. The length of the cable was not quite 5 kms. and thus CW=40, but as the insulation was only 10 megohms, it was impossible to use the cable. This was a Brooks cable with petroleum insulation.

Those experiments too have been cited against the calculations of the theory, in which two cable wires alongside of each other are used to make a complete circuit. By applying the fundamental principles of electrostatics it is easy to show that such a circuit is an entirely different thing from a simple cable wire. We assume that both wires are immediately alongside of each other. Let us take from this double circuit two neighboring sections and call their length 1. Let us call their capacity with reference to their common metallic covering c. Then the mass of electricity contained in one wire is proportional to $+\frac{dP}{dt}.c$; and in the other wire to $-\frac{dP}{dt}.c$; the sum of both is equal to zero. Thus no electricity at all is held and such a cable is as though its capacity were zero. But the capacity of both wires is not exactly the same, since we have to consider not only the capacity of the wires with reference to their common metallic covering but also that of one wire with reference to the other, and in consequence of the loss of current the potential would not be equally great at all points of the cable; so that even in the case of long circuits the influence of capacity would be perceptible.

This would be largely determined by the insulation, the method of manufacture and the character of the wires of the cable.[5]

The experiments of Messrs. Felten & Guilleaume (see *Elektrotechnische Zeitschrift* p. 505, 1883) on the telegraph cable between Köln and Elberfeld belong in this connection. This cable is 55 kms. long, has a copper resistance of 6.5 ohms and a capacity of .2 mf. per km. so that CW=3932. Articulation through this cable was entirely good. Double circuits of this kind were employed in several of Preece's experiments also.

The conditions recounted above lose their applicability in those telephone cables in which the separate wires are electrically insulated from one another by metallic coverings of lead or tinfoil. The wires of such a cable are like the same number of entirely independent lines and thus we could not effect the same improvement by making use of metallic circuits as in ordinary telegraph cables.

B. LINES WITH GREAT SELF-INDUCTION.

We now turn our attention to a line without capacity but with great self-induction, which latter acts like an electro-motive force. According to the law of Neumann this is proportional to self-induction P, and the variation of current strength J, and the Ohm law would accordingly be

$$E - P\frac{dJ}{dt} = J.\,W.$$

If the electro-motive force has the form of a harmonic wave $E = A\cos 2\pi nA$, then the strength of the current would be

$$\text{III.}\quad J = \frac{A}{P\sqrt{1+\left(\frac{W}{2\pi n P}\right)^2}}\cos(2\pi nA+\delta).$$

The value P is composed of two parts: the self-induction of the apparatus switched into the circuit p, and the self-induction of the circuit q. The self-induction of the apparatus depends upon the form of the magnets, and especially upon the form and size of the iron core. It must always be ascertained by experimenting.

The self-induction of a circuit wire whose length is l and whose radius is r is represented by the equation

$$q = 2l\left(\ln\frac{2l}{r} - .75\right).$$

We must observe that according to the experiments of Hughes and the theoretical results obtained by Maxwell and Rayleigh[6] the resistance W as well as the self-induction q depend for harmonic oscillations on the rapidity of the current waves, and the resistance becomes greater with an increasing number of oscillations, and self-induction becomes smaller. If μ be the magnetizing constant and ρ the resistance of a circuit whose length is 1, then the formulas of Rayleigh give us,

$$\text{in case } \frac{\mu^2 n^2 \pi}{\rho^2} < 1,$$

this formula for the apparent resistance:

$$W^1 = W\left[1 + \frac{1}{3}\frac{\mu^2}{\rho^2}\frac{n^2}{\pi^2}\right]$$

and for the apparent self-induction :

$$lq^1 = l\left(q + \mu\left[\frac{1}{2} - \frac{1}{12}\frac{\mu^2 n^2 \pi^2}{\rho^2}\right]\right).$$

If on the other hand

$$\frac{\mu^2 n^2 \;{}^2}{\rho^2} > 1$$

then the apparent resistance gives us :

$$W^1 = l\sqrt{\pi n \mu \rho}$$

and the apparent self-induction is

$$lq^1 = l\left[q + \sqrt{\frac{\mu\rho}{4\pi n}}\right].$$

In the telephonic transmission as a rule only the letter values are taken into consideration. If we introduce these into the formula for J we have

$$\text{IV. } J = \frac{A}{[p + l(q+\alpha)]\sqrt{1+\frac{\alpha^2 l^2}{[p+l(q+\alpha)]}}}\cos(2\pi nt + \delta),$$

$$\text{in case } \alpha = \sqrt{\frac{\mu\rho}{4\pi n}}.$$

The factor α contains the number of oscillations n, and for this reason J is one of its functions.

Their mutual dependence is such that as n increases the strength of the current increases likewise. The relative intensity of separate partial tones is consequently changed and the extent of this change is determined by the resistance and the self-induction of the apparatus in the circuit, according to the above formula. To obtain an insight into the nature of this influence, we will apply the formula to a line 300 kms. in length, which is in the first instance a copper wire of 2 mm. diameter, and in the second instance an iron wire of 5 mm. diameter, so that both lines shall offer equal resistance. We can make the magnetizing constant μ for copper equal to 1. What this value is for iron wire is as yet very uncertain. According to the most recent measurements of Rayleigh it seems to be about 100.—(*To be continued.*)

An eminent civil engineer of St. Louis expresses the opinion that electricity will supplant gas for illuminating purposes within the next decade, and that the pipes now used for the transmission of illuminating gas will, during that time, be given up to the uses of fuel gas. The present illuminating gas companies will go into the business of manufacturing fuel gas, and will not be ruined by the advance of electricity. For fuel, gas will have to be manufactured. Natural gas will not supply the demand. The natural gas wells are becoming exhausted, and they can not be relied upon for a steady supply. Everywhere one has been opened it has been drained in a little while. Those around Pittsburgh will last longest, but they will refuse to flow, too, after some time, and then coal will have to furnish the gas

5 W. Thomson, Phil. Mag. p. 135, 1857.

6 Phil. Mag. p. 381, May 1886.

An Electrical Device for Controlling Trains.

In our issue of September 3d we described a plan devised by a Chicago inventor for averting railway collisions on single track railroads by the use of an electrical apparatus. A number of inquiries relating to the apparatus have come to us, and we give place to illustrations which will enable the reader to gain a clearer idea of the design of the inventor, Henry A. Richards, and repeat enough of the original description to explain the diagrams.

In diagram A, *b* is a cast-iron box three feet

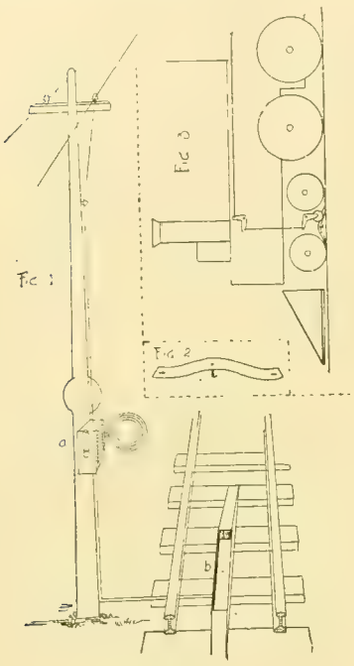

Diagram A.

long and four inches wide. These boxes are the same height as the rails, and are placed in the center of the track at intervals of about a mile apart on a straight road and at less intervals on a crooked road. They are bolted to the ties. Inside the box is a flat steel spring, shown in Fig. 2, with a hook on the under side, which holds it down. This hook is released by the train dispatcher by an electric appliance very similar to the fire alarm system in cities. The electric wire will communicate direct with the train-dispatcher's office by means of the ordinary telegraph poles, as shown in Fig. 1. When the spring is released it forms an obstruction which is met by a device to be placed beneath every locomotive between the truck wheels. This device is shown in Fig. 3. It consists of a bell crank with a small wheel at the extremity, so constructed that when it meets the spring a motion is created which is transmitted to the cab of the engine. This motion can be utilized either to set the air-brakes or to ring the bell. In either case the engineer has received warning of danger and stops his train.

Attached to the telegraph pole which conveys the wire from each spring is a box similar in appearance to fire-alarm boxes. The same touch that releases the spring also releases a target and ignites a fuse, which lights a ball of red fire and throws out minor balls at intervals, after the fashion of a Roman candle. Both these signals are to attract the engineer's notice, and there should be no portion of the road where one or the other could not be seen by the engineer whose train is in danger. These boxes are all provided with keys to be in possession of every employe, and by means of them immediate communication can be had with the train-dispatcher's office. The latter will contain a keyboard like a hotel annunciator, and the drop of a key will show the box on the line where the signal is from.

Diagram B shows the application of Mr. Richards of the principle of the mercurial fire alarm to a wooden bridge, the design being to notify a train-dispatcher of the existence of a fire on or near the bridge. Iron pipes filled with mercury —as will be noted in the diagram—are let into the stringers and uprights. A wire is carried through the top of an upright pipe to within a short distance of the mercury. Any expansion of the mercury by heat closes an electrical circuit, and an alarm is sounded and indicated on an annunciator or similar device.

Mr. Turnbull's Telephone Trouble.

A dispatch from Baltimore, Md., under date of the 9th, says: William C. Turnbull, inventor of a long-distance telephone, returned to-day from a visit to the Chinese minister at Washington, before whom he laid all the particulars of his grievances at the action of Count Mitkiewicz and others in obtaining large concessions from the Chinese government for the use of the Turnbull telephone. Mr. Turnbull talked of the matter in a philosophical and business-like way, and hopes in some degree to share the profits from the use of the instruments in China, or at least be paid something handsome for their use. The letter written Secretary Bayard, May 24th, 1887, by Mr. Turnbull, asking that some action be taken against the Chinese use of the telephone, was found yesterday in the department of state. Nothing had been done with it. Mr. Turnbull thinks it was unintentionally overlooked, but stated it is the opinion of Washington people that if action had been taken in the matter the Chinese government would have been on its guard and the granting of concessions would never have taken place. Mr. Turnbull yesterday presented to the Chinese minister a copy of his agreement with Count Mitkiewicz and Paine. Mr. Turnbull explained that the count had never carried out his contract with him, and consequently could have no interest in the telephone. The secretary of the Chinese legation had yesterday received Mr. Turnbull's letter to Secretary Bayard and understood the whole matter. The secretary regretted that his government had made concessions to a party who had no interest in the telephone, but being a commercial matter he could take no action in it, and thought the affair should be arranged between Mr. Turnbull and Wharton Barker, the wealthy Philadelphia banker, who is one of the syndicate to whom the concessions were granted. The original agreements between Mr. Turnbull and Count Mitkiewicz and his partners was for the establishment of a company in Virginia with a capital stock of $6,000,000. After three extensions the time for this elapsed Oct. 15th, 1886. Mr. Turnbull has his patents in the United States, Great Britain, France, Germany, Belgium, Austria, Canada, and elsewhere, and the

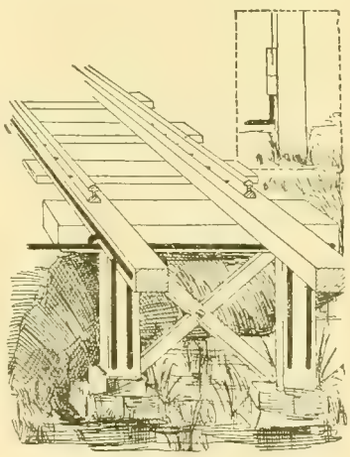

Diagram B.

syndicate will have to put a plant in China or elsewhere outside of these countries for the manufacture of instruments. Mr. Turnbull does not intend to call on Wharton Barker, but expects that gentleman to come to him and offer some remuneration for the use of Mr. Turnbull's instruments in China. As China grants no patents the syndicate has done nothing illegal, but still Mr. Turnbull thinks they should pay him if they use his instruments. For the present Mr. Turnbull will do nothing more, but await the course of events.

CORRESPONDENCE.

Eastern Electrical Comment.

New York, Sept. 10.—The first entertainment of the season under the auspices of the Board of Electrical Control took place in the mayor's office at City hall, on Wednesday. His honor's vacation at Bar Harbor had not removed the irritation which always manifests itself when he settles down to business opposite Mr. Gibbens. The latter being a young man, Mayor Hewitt assumes that he is ignorant and freely expresses his contempt in very cutting remarks. Mr. Gibbens presented a letter from the attorney general, in which that gentleman stated that as the question of subjecting candidates for positions to examination was already pending before the mayor, he thought it proper that the corporation counsel should decide the matter. This is interpreted as being a decision in favor of the mayor. Now it remains to be seen whether the civil service board will depend upon a candidate's knowledge of history and geography to determine his fitness for giving electrical advice to the board. The absurdity of the whole business was shown by the fact that nineteen inspectors have been employed by the department of public works to see that the pavements were properly placed, while two gentlemen of experience in underground work say that one section on Broadway has a decided dip between manholes, indicating that something else besides the pavements needs watching. Contractor Crimmins discharged a large number of men this week on account of having completed the subways authorized by the board. The work has progressed simultaneously for about two months in both uptown and downtown districts. On the west side of Broadway, between Seventeenth and Thirty-third street, thirty tubes have been laid, six being for electric light wires, and twenty-four for telegraph and telephone wires. On the east side, from Twenty-first to Twenty-sixth streets, twenty-four tubes have been laid for telegraph and telephone wires. The Brush Illuminating company has already ordered an eleven-conductor kerite cable for its underground lines in that vicinity. Conduits have also been placed in the cross streets from Broadway to Sixth avenue below Twenty-third street, and from Fifth to Sixth avenues above Twenty-third street. John Thomson, who served the old commission as mechanical expert from September, 1885, to September, 1886, has brought suit in the supreme court against the state controller, Chapin, and Jacob Hess, Theodore Moss and Roswell P. Flower, commissioners, for $3,000, salary for services. He claims that funds have been received and utilized for other purposes which should have been devoted to the payment of employes. During the past week a check has been received from the Baltimore & Ohio company for $2,000, as its assessment for the expenses of the commission. It was accompanied by a protest, but such a protest will probably not prevent the negotiation of the check.

Contractor N. B. Amory, who had been constructing the Seashore Electric railway at Asbury Park, N. J., for the Daft company, disappeared early in the month, without paying his men for their last two weeks' services. It is alleged that he borrowed a considerable amount of money to carry on the work, which has been delayed for various reasons. A successful trial trip of the electric car was made, however, September 7th, much to the delight of the citizens and the few remaining guests who had not departed with the advent of the first cold wave.

An arc lighting plant has just been started at the Parlor Rock pleasure grounds on the Housatonic railroad, a few miles from Bridgeport, Conn. It consists of a 25-light dynamo driven by a 35 horse power turbine wheel, supplying a current for 17 lamps. It is the intention of Col. Stevenson to erect a toboggan slide this fall and try the experiment of utilizing the grounds during the winter. This will fill a long-felt want in increasing the earning capacity of picnic grounds.

An abandoned submarine cable over 2,000 feet in length was picked up in the outer harbor at Bridgeport a few days ago. It consists of a stranded conductor made up of seven small wires insulated and armored. None of the old salts in that vicinity have any knowledge of such a cable having been laid, and there has never been

a line so near the shore, of which it could have formed a part. It is supposed to have caught in the keel of some heavily laden coal barge which dragged it from the bottom and brought it from some other locality.

An air of mystery pervaded the new telephone building during the past week, where a private conference was held bearing on the question of the best form of cable for telephone work. Messrs. Barton and Patterson of Chicago, W. W. Jacques of Boston, Messrs. Sargent, Hibbard, Hall and Barrett of New York and Brooklyn were in attendance. Several papers were read and a general discussion followed giving the experience of these gentlemen.

Frank B. Rae, who left this city for China last March in company with Mr. Barberie, has returned with the party, and will spend about six weeks in the east. The papers have been well supplied for a few days with repetitions of the old adventures of Count Mitkiewicz, who has secured the alleged telephone concession in China, and is now making efforts to start a China-American bank. According to these various stories the count, during his past life in this city, has at times sorely felt the need of a bank. Inventor Turnbull of Baltimore who gave the count a contract for the use of his telephone, is now hovering around the Chinese embassy in Washington, endeavoring to ascertain where *he* comes in, now that the negotiations appear to have brought forth some money. There can be little doubt that cash has been secured, as the count is paying up his old debts.

There is a very plausible rumor to the effect that a new syndicate has been formed to pool the opposition telegraph companies, instead of allowing them to fall into the hands of the Western Union company as they are likely to do if they continue to maintain separate organizations. The rent paid in this city is a heavy burden for all of them. P.

New York's Board of Electrical Control.

New York, Sept. 10.— The Board of Electrical Control has resumed its sessions, and as usual the proceedings, particularly when Mayor Hewitt and Mr. Gibbens tilt at each other, are racily set forth in the daily papers. The proceedings generally furnish rich reading and form the comment of the electrical people of this city. At the last meeting of the board a letter was read from the acting commissioner of public works notifying the Consolidated Telegraph & Subway company that it must not continue its work without getting new permits. The letter also said that the existing permits issued by the board of public works were insufficient to warrant the disturbance of the streets. The opinion came from the corporation counsel.

Another communication from the commissioner of public works complained of the shape of the manhole heads. It said that they were difficult to join to the pavement, and requested that future manhole heads be made in a rectangular shape and vertical on the sides. The trouble had been rectified by the engineer.

Leonard D. Beckwith, chief engineer, then presented a lengthy communication in which he requested the extension of the Sixth avenue subway south from Twenty-first street, down Sixth avenue, through Fourth street, South Fifth avenue, and West Broadway to Chambers street, also a subway on Whitehall street from Water to Beaver and through Beaver to Broad street, with a branch on Battery place and Bowling Green from Greenwich to Whitehall streets. It also included several minor requests. The line on Fifty-eight street, from Third to Eighth avenues, is completed, with the exception of the crossing at Fifth avenue. The work on the Broadway and Park row branches is going on slowly, but the engineer excuses himself by saying that this subway contains 104 ducts in one part and 70 in another, thus making it not only the largest in the city, but the largest in the world, and that the crowded condition of Broadway both above and below ground accounted for the delay. On calling the roll these requests were granted, Mayor Hewitt as usual voting no.

Mr. Gibbens then moved a resolution requiring all electric light companies to make application for new permits. This was carried unanimously. When the mayor voted "aye," the clock stopped.

Mr. Gibbens went into a rambling talk that ended up in a resolution that the subway company be requested to furnish the board rules and regulations for the use of the conduits. Carried. The mayor again voted "aye."

Mr. Gibbens again got his work in with a resolution that the corporation counsel be requested to act as counsel for the board of Electrical Control. The mayor voted "aye" again, at which Commissioner Gibbens smiled, but he cooled off quickly when the thought struck him that the mayor had scored another point on his own resolution.

Mr. Moss then dumped a bushel basket full of requests for local connections of the different electrical companies. Mr. Gibbens asked if any of them contained requests to erect new poles. They did not, and were granted in a bunch.

Mr. Gibbens moved that the Safety Electric Light & Power company be given permission to do business in this city. They did not ask to put up poles or string wires, but simply asked to be allowed to do business. After the permission, then the question of the manner of stringing the wires would be taken up.

This Mayor Hewitt thought was nothing but a rat hole. He wanted a resolution saying just exactly what is wanted, and not have a hole left where any company may proceed to erect poles.

Mr. Gibbens tried to explain and did so several times, but the mayor said: "I shall not vote for that; there is a loophole that will allow them to erect poles."

Mr. Gibbens tried to explain again, but the mayor wouldn't have it. Mr. Hewitt then moved that the Safety Electric Light & Power company prepare a request and that it be submitted to the corporation counsel for approval. This was carried, and Commissioner Gibbens surprised the mayor by voting "aye."

A gentleman of the name of Oliver then asked the attention of the board for a few moments while he extolled the merits of the O'Brien conduit.

Mayor Hewitt—Is it a patent?

"It is, and the best conduit in the world."

"Then I don't want to hear about it. Go to the engineers, and if you have got a good thing they will buy it."

Another inventor—I have a word to say. I, too, have a conduit which I claim to be the best. I only ask for two minutes.

"What is your name?"

"Levine, sir."

"Well, Mr. Levine, I will time you just two minutes."

The mayor took out his watch. Mr. Levine talked two minutes, and then the mayor said:

"I move that Mr. Oliver be appointed a committee of one to listen to Mr. Levine, and then let Mr. Levine listen to Mr. Oliver. I am tired of this business."

The mayor said this very testily, and the two gentlemen subsided. Nothing further of importance was done, and the board adjourned. C.

New York Notes.

New York, Sept. 10.—The commissioner of public lighting, September 1st, awarded the contracts for street lighting to the following companies: East River Electric Light company, 244 lamps at $19\frac{9}{10}$ cents, and 197 lamps at 39 cents; United States Illuminating company, 15 lamps at 24 cents, and 38 lamps at 40 cents; Brush Illuminating company, 91 lamps at 25 cents, and 23 lamps at 40 cents; Mount Morris company, 7 lamps at 60 cents. 12 lamps at 50 cents, and 116 lamps at 24 cents; American Electric Manufacturing company, 93 lamps at 32 cents, and 26 lamps at 40 cents.

The laboratory that Mr. Edison is building on Lakeside avenue, Orange, N. J., will be the largest and most complete laboratory in the country. The structure is of brick, three stories high, and is 60 feet by 250 feet. The lower floor will contain a library of several thousand volumes on scientific subjects, and will be handsomely finished in hard wood. On the same floor will be placed the boilers, engine and heavy machinery. The two upper floors will be divided into smaller rooms for experimental purposes.

One of the daily papers recently published a long description of the country residence of E. H. Johnson, president of the Edison Electric Light company, at Greenwich, Conn. He has made use of electricity in every possible manner, and done everything in his power to show what can be done in the way of lighting up a country place. Electric lights are placed in great profusion, not only through his house, but in the piazzas, on the flag-pole, along the drives, the barn, and stables, and on the tennis grounds. There are no less than 200 lamps used in front verandas of the house, and it is said that at night the effect from a distance of several miles is very brilliant and unique. In addition to its use for lighting, electricity pumps the water from six wells, opens the gates, sends signals through the house and grounds, works an organ, regulates the temperature of the house in winter and summer, curry-combs the horses, etc. The electricity for all this work is furnished by two number 10 Edison dynamos driven by a forty-horse power engine. A secondary battery of 120 cells supplies the current when the dynamos are not used.

The recent terrible theater fire in England has emphasized the necessity of displacing gas by electricity in theaters, especially about the stage. The Broadway theater, now being built in this city, will be entirely lighted by electricity, and will be as nearly fire-proof as possible.

At a meeting of the Board of Electrical Control, Thursday, the construction company was authorized to build subways on Sixth avenue from Twenty-first street to Fourth street, then down South Fifth avenue and West Broadway to Chambers street, where it will connect with a line of communication already authorized, and another on Whitehall street from Water to Beaver to Broad street, with a branch on Battery Place from Greenwich street.

General manager John B. Powell, of the Brush Swan Electric Light company, has resigned his position, and has brought suit for $1,000,000 against the Brush Electric company and the Brush-Swan company of New England, for non-fullfillment of contract made in 1883 to furnish him storage batteries.

Last Saturday the New York Electrical society joined the Society of Amateur Photographers and the photographic section of the American Institute in a trip to Glen Island.

The new club house of the Electric Club will probably be ready by October 1st. S.

From the Pacific Slope.

San Francisco, Sept. 5.—The Japan Railway Co. are making preparations to light their stations by electric lights.

Mr. Rich, at San Jose, intends to construct another road upon First street to the cemetery as soon as the electric motor road on Santa Clara street is completed.

At Los Angeles the Pacific Electric Railway have filed articles of incorporation. The city council have granted them a franchise to build and operate an electric railway within the corporate limits.

The Oakland Gas Light & Heat Co. have received additional dynamos, and will light the parks and streets. Preparations are being made to increase their steam power.

The Plumas Eureka Mining Co. have ordered an incandescent plant of the Jenney Electric Co., Indianapolis, for their 60-stamp mill at Plumas, which is controlled by the Sierra Butte Mining Co. Wm. Johns is the manager.

The Young America Mining & Milling Co., at Sierra City, have also ordered an incandescent plant of the same company.

Throughout Nevada, Placer, and other countries can be seen half-sheet posters bearing the following notice: "Electric light races, Sept. 8th, 9th and 10th, at Placer and Nevada County Fair." Your correspondent went to Grass Valley see the preparations for the event. Three miles above the town was found a race course, and also Manager A. A. Osborne, of the Waterhouse system of Grass Valley and Nevada City, very busy superintending the installation of lights of the Waterhouse system to light the course during the races, which are to be run after 8 o'clock for the three evenings, to give all the miners and business men from the two counties a chance to

attend. The current is to be furnished from their station, about one and one-half miles above Nevada, where they have a water power station, and from which they light the two towns, about four miles apart. They have four hundred feet head of water, and pay sixteen cents per inch for water for twenty-four hours' run. They take one inch per lamp, or horse power. The dynamos are connected direct to the water wheel. Preparations are being made to transmit power to several places where hoisting is done, and there is some talk of building a motor road between the two towns. Mr. Waterhouse is expected there when the races are run.

A miscreant sneaked into the dynamo room of the electric light company at Santa Rosa, the other night, while the superintendent and engineer were in another part of the building, and threw a pail of water over the dynamo that runs the one o'clock circuit; damage $2,200.

The Sierra Butte Mining company will give a supper and dance at the office of their works, in honor of having their mill, works, office and mine lighted by the incandescent light, October 1st. The Indianapolis Jenney system has been put in. Mr. Preston, the superintendent, expresses his satisfaction with the incandescent light for mines and mills, and will at once begin preparations for using motors in the tunnels and workings of the mine to haul the ore out. They have 1,200 feet head of water. S.

Omaha Gossip.

OMAHA, Neb., Sept. 12: The Edison incandescent plant, recently installed in the Paxton hotel, served as a starter for that system in this vicinity. Since then a plant of 255 lights has been completed for Fowler Bros. in their packing house, at South Omaha, one of 1,000 lights for the six-story Paxton business block is being put in, and another of 500 or more for the new Murray hotel will be begun this week. W. M. Hand, representing Leonard & Izard, of Chicago, has the work in charge. The United States Co., represented by Mr. O'Brien, of Chicago, has increased the capacity of their isolated plant in this city, that of C. S. Higgins. It now lights two saloons, two large restaurants, a residence and stable, and comprises about 400 lights.

The Thomson-Houston Co. are agitating the question of electric motors, in addition to their already extensive plant.

The Nebraska Telephone Co. are now located n their commodious and neatly arranged new quarters on the fifth floor of the new Ramge block. A multiple switch board, of the Western Electric Co.'s latest pattern, works like a charm, and affords their subscribers much relief and satisfaction. The vigorous "kicks" heretofore are now but a memory of the past. The telephone company are justly proud of their new system, as it embodies all the latest improvements, outrivaling that of the Metropolitan company in New York city. The executive officers of the company adjoin the exchange and are all that could be desired. They have lately extended and rebuilt several of their most important "leads" from central office, using only sixty foot poles. A method of attaching cross arms has been adopted which we have not seen anywhere. One arm is put on in the usual manner, then another is placed bottom upwards and just below the first. Both are braced from either side with light iron. Porcelain knobs are then used on the under cross arm with pins on the one above. This not only economizes space but adds greatly to the appearance of especially tall poles.

The underground "reform" has not yet struck us and probably will not very soon, as all lines in this city are in excellent shape and actually considered an ornament by not a few prominent citizens.

Another Bell company competition has appeared in this state. A line is being operated from Clay Center to Fairfield. The capital stock of the company has been increased and lines are to be built at once to Edgar, Harvard and Sutton. The instruments used are manufactured by a St. Louis firm. No action has been taken against them by the Bell company so far as heard from.

The city council of Council Bluffs, Iowa, has decided to adopt the electric light for the city, and have about closed the contract with the company now operating there.

Electric light plants will be reported at a dozen or more towns in this state before the season closes.

The Midland Electric Co. made a neat and very creditable display at the Omaha fair last week, and have taken the same to the state fair at Lincoln, this week.

E. H. Cone, of the Electrical Supply Co., was a welcome visitor last week. W.

Cincinnati Chat.

CINCINNATI, Sept 10.—The great superiority of the electric light over gas and other illuminants is shown nightly at the representation of "Rome under Nero," and this was never shown to better advantage than the night the shafting broke and compelled them to substitute something for the electric light. Gas, and calcium lights, and locomotive headlights, in fact, everything was tried but all to no avail; the same effect could not be produced.

W. L. Silvey, one of the Queen City's young electricians, has made some interesting inventions in the line of dynamos and motors, and one of his inventions that is attracting considerable attention is an electric headlight for locomotives that promises to make for him a name among the electrical inventors of this country. His motor for street railways perhaps will receive a trial on the electric railway soon to be put in operation in this city, along with the Van Depoele, Sprague and Daft systems. Mr. Silvey will leave for Lima, O., next week, where a stock company will be formed for the manufacture of his inventions.

The electrical department will be one of the leading features at the Centennial exposition to be held in this city during the summer of 1888. Extensive preparations have been begun for the construction of a building in Washington park, to be connected with the regular exposition building. As near as practicable the material used in the construction of these buildings will be glass and iron.

The Standard Electrical works of this city have contracts for fitting out several hotels with the Hess system of guest call, fire alarm and gravity drop annunciators, the largest being a new hotel at Fort Wayne, Ind. They report business on the increase.

C. E. Jones & Bro. are doing their share of the bell hanging and annunciator work. They are Cincinnati agents for the Western Electric Company, of Chicago.

Dr. Henry Nichols, inventor of the quadruple system of telegraphy, is not satisfied with sending four messages over the wire at once and is completing an instrument he designates as a sextuplex. M.

Detroit's Budget.

DETROIT, MICH., Sept. 12.—Four months have already been consumed trying to make a contract for lighting the city. The city counsellor now discovers that since the mayor vetoed the first resolution to contract with the Brush company, it would be illegal to enter into the modified contract without re-advertising. The city attorney does not share the opinion, but the whole thing must be gone over again, the controller having been instructed by the upper house to re-advertise for the public lighting. It is reported that the Brush company, if awarded the three years' contract, would be willing to have incorporated in it a clause stipulating that it should put all its wires on Woodward avenue, as far north as Grand Circus park, underground, with the further provision that if this proved to be practical, it would put all its wires within the half-mile circle, underground without delay.

The Grand Rapids Electric Light company has begun suit in the United States court to restrain the Edison Light company from erecting poles or stringing wires in the city. The complainants claim to have an exclusive franchise of the city for fifteen years from 1880, granted by special ordinance. Judge Severns issued an order to the defendant company to show cause why an injunction should not be issued. C.

THE ELECTRIC LIGHT.

An ordinance has been passed by the town of Lake View requiring the Lake View Electric Light company to use hard coal for their engines or provide smoke-consumers.

The Chicago Edison company has been obliged to suspend operations in regard to laying its wires in the streets of the city until it lays them in conformity with the ideas of George B. Swift, commissioner of public works. It appears that the company, in laying its mains, is putting in connection joints every twenty feet, and the commissioner insists that the connection pipes shall be extended to the curb wall to avoid the further tearing up of the street. To this the company objects, on the ground that it has no consumers as yet, and says that it will put in the curb connections as wanted. At present operations are at a standstill.

M. Clingmann has been experimenting with zirconium as a substitute for carbons for electric lighting, and it is said that the experiments have been successful. Pencils of this material will last for several months in an arc lamp, it is reported.

A Mr. Ellis Lever, of England, has offered two premiums of £500 each, on condition that the government will undertake the necessary tests and make the awards, for a safe system of electric lighting in mines, to supersede the present so-called safety lamp, and for the best method of safe blasting in coal mines without the use of gunpowder.

"Doctor," he said to a Topeka dentist, "I have a horrible toothache; can you pull out this fang without pain?" "Certainly, sir." "How'll you manage it?" "I'll administer gas." "That won't do. I'm interested in the electric light plant.

Holton, Kansas, is to have a 200-arc light plant.

The Nickerson Electric Light company, of Nickerson, Kan., have purchased a lot on the west side of Payne street and C avenue on which to erect their plant. It is an admirable location. The company will also investigate the practicability of a telephone in connection with their works and Hutchinson.

The dynamo and all the apparatus for the Parsons, Kan., electric light plant, with the exception of the engine, are on the ground.

Florence, Kan., is talking of adopting the electric light.

The electric light plant recently operated by Messrs. Peck and Miller, at Galena, Kan., has been purchased by E. W. Pike. The plant is of 65-light capacity. Mr. Pike has consolidated his electric light and gas plants under one roof, and therefore is in position to supply either light.

The electric light plant has arrived at Brainerd, Minn., and will be located and prepared for use at once.

The electric light ordinance was passed by the Jackson, Mich., council over the mayor's veto.

The Belvidere Electric Light company at Belvidere, Ill., has been incorporated; capital stock, $8,000; to furnish electric light and power; incorporators, S. L. Coney, Frank W. Plane, Chas. E. Fuller and others.

An electric light installation of arc and glow lamps has just been completed in the colliery known as the Sacré-Madame, near Charleroi. The work has been executed by the Societé Electricité et Hydraulique, under the administration of M. J. Dulait. It comprises 12 arc and 250 glow lamps, the current being supplied by two slow speed Dulait dynamos, each giving an output of 250 ampéres at 100 volts at 425 revolutions. Each dynamo is driven by a separate 35 horse power steam engine. The dynamos are coupled in parallel by means of a switch board where the current is divided into five circuits, each of which is served independently of the others. The installation is one of the most complete in the district.

At the Brussels exhibition, it is proposed to erect two 5,000 to 6,000 candle power arc lamps at the main entrance on masts 60 feet high. Each arc lamp will receive current from its own small dynamo driven by a turbine, the generating

plant being placed inside the pedestal of the mast. Water power will be supplied from the town mains.

Eric Bruce, who has worked out the idea of signaling at night by a captive balloon lighted inside by electric incandescent lamps, has just completed one for the Belgian government. Mr. Bruce's latest balloon is fifteen feet in diameter and 2,000 cubic feet in capacity. It is made of varnished cambric, and is translucent. Six Edison and Swan lamps of eight to ten candle-power are mounted inside, and the current is supplied by an E. P. S. accumulator of twenty-five cells of the eleven S type in teak-boxes.

The New Orleans Gaslight company has enjoined Morris J. Hart and others from erecting electric light towers, on the ground that the foundation for the same will interfere with their pipes and mains.

The public supply of electricity from central stations is not limited to Berlin only, but is beginning to obtain a footing in various provincial towns throughout Germany, writes the Berlin correspondent of *Industries*. I have recently visited several places where stations have been erected, the more important amongst them being the following: In Hanover there are two small stations already in activity, one for the supply of private customers and the other for the lighting of the court theater. In this case alternating currents and transformers ars used, the transmission being by means of an overhead iron wire 100 mils in diameter, at a potential of 1,200 volts. The total commercial efficiency of the system is 58 per cent. A larger central station with underground cables for the supply of the inner portions of the town is in contemplation. In Magdeburg there is a small central station for lighting a block of houses, including hotels and shops, in the neighborhood of the railway station, and in addition to this a separate installation for the theater is now being fitted up. There will be two gas engines of 35 horse power each placed in an annex, and the building will be lighted from the dynamos direct. The works of Gruson and Schäffer & Budenberg in Buckau have also special electric light installations. In Brunswick a private person has erected a central station for 1,000 lamps, all the lights being in a block of houses containing business premises. In Dessau, which is the headquarters of the Continental Gas company, there is a very interesting installation which has been at work since last year, lighting principally the court theater and the castle with about 2,000 lamps. Power is furnished by four Otto gas engines, two of them 60 horse power and one 30 horse power, working together on a countershaft, from which two 600-light and one 450-light dynamos are driven. The fourth gas engine is an 8 horse power working a 100-light dynamo, which is used for charging a battery of Khotinsky accumulators, having a total capacity of 600 lamp-hours. The cost of the whole installation was about £15,000.

THE ELECTRIC MOTOR.

An electric motor has been fitted to one of the derricks used in hoisting the stones for the new capitol now in course of erection at Topeka, Kan. The motor is of about eight horse power and is calculated to hoist a huge stone sixty feet in two minutes.

The Cleveland *Leader* hopes for the early introduction of electric street cars.

The mayor of Lake View has vetoed an ordinance granting permission to the North Chicago Street Railway company to experiment with electricity in operating their cars on North Clark street between Belmont and Lawrence avenues.

THE TELEPHONE.

Three suits have been begun by the American Bell Telephone company in the federal court against Charles Tomlinson and Josiah Cushman of Mount Carroll, Ill., and Martin Harnish and S. J. Harrison, of Lanark, Ill., to restrain them from using telephones which are claimed to be an infringement on the Bell patents.

A project is on foot of connecting Florence, Kan., and Marion, by telephone.

The minister of the interior of the government of Spain has advertised for 14,000 meters of fourteen-conductor and 30,000 meters of double-conductor telephone cables. Bids will be opened the 19th inst.

The "White Caps" of Vincennes, Ind., have posted a notice that L. Johnson, proprietor of the Vincennes telephone lines must go. He had been appointed agent by Andrews & Co. to collect driven well royalties, and this aroused the indignation of citizens.

The placing of wires under ground is being opposed by the town council of Berlin, Germany, who object to the frequent disturbance of the pavement, and are endeavoring to levy from the post-office a tax for the use of the streets in the same way as they levy a tax from electric lighting companies who use the streets. Generally the town authorities raise no objection to overhead wires, and are even disposed to consider them as an element of safety. It has been observed that during recent thunderstorms those portions of the town which are most thickly covered with telephone wires enjoyed complete immunity from strokes of lightning, whereas damage was done in other districts. The explanation of this fact is that a large number of the posts supporting telephone and telegraph wires have purposely been connected with earth, and these posts form, together with the network of wires, a fairly efficient protective system.

Three weeks ago the Bridgewater Gas company laid mains from their wells, near Pittsburgh, to East Liverpool, O., a distance of forty miles, and inside placed a telephone wire. Recently the gas was turned on and in a few minutes a hammer, a pick and a ball of lead, which articles had been accidentally dropped into the other end, shot out of the pipe and with the hammer came the telephone wire, a most peculiar tail to a most peculiar comet.

THE TELEGRAPH.

The uniform telegraph rate of 12 cents a message has now been in operation in Great Britain two years, and the gross revenue is now larger than it was at double the present rate. The number of messages has increased one-half, and the average of words in the messages has considerably.

The inland — Japanese — messages passing through Nagasaki last year numbered 201,979, against 142,250 in the preceding year. The foreign messages—outward—were 17,501, against 15,134 in 1885; inward, 17,322, against 15,874 in 1885.

The broken French cable has been reunited, the company announces that communication with Europe has been restored, and that it is now ready to accept telegrams.

Kalamazoo has a telegraph operator who is 19 years old and but forty-four inches high. He has to have a platform on which to do business.

NEW ENTERPRISES.

The establishment of a canning factory at Flatrock, Ind, is under consideration.

Plans and specifications for a machine shop for the state school of technology will be at the office of Bince & Morgan, architects, Atlanta, Ga., until Sept. 30th. Communications should be addressed to the commission on school of technology at the same place.

Council Bluffs, Ia., is to have a government building.

Personal Paragraphs

H. Ward Leonard, of Leonard & Izard, last week was confined to his home by an injured foot. A piece of a broken toilet bowl fell on his foot, cutting a severe gash to the bones.

John Gamble Horne, for twenty-six years head of the financial department of Pinkerton's detective agency of Chicago, died last week at the ripe old age of seventy years. Mr. Horne was born in Canada, and for many years served the Bank of Montreal as a teller, and later as manager of their London, Ont., branch. He left a wife and a son, F. W. Horne, western manager of the Excelsior Electric Light Co.

C. D. Jenney, of the Jenney Electric company of Indianapolis, paid the WESTERN ELECTRICIAN a visit last Tuesday.

Dr. Cutler and Col. Jones, of Independence, Mo., were in Chicago the early part of the week investigating the advisability of adopting the storage battery in connection with their proposed electric light plant.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	385	400
Central Union	44	45
Michigan	72	73
Great Southern	28	30
Colorado	18	20
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27
Missouri & Kansas	69	70

Miscellaneous Notes.

Platinum has been discovered near Clinton, Mo.

A Wall street man who has close relations with the Western Union Telegraph company, tells a good story about Mr. Flower, and by implication gives up Jay Gould as authority. Mr. Gould figures in the story. Back in the times when Mr. Flower, as an electrical subway commissioner, was insisting that New York's telegraph wires should go under ground, Mr. Gould dropped in on him one day, and remarked that he had made a friendly call to talk over the underground business. Mr. Gould didn't see why there should be so much fuss over a little thing. He didn't believe Mr. Flower could really be informed of all the interests involved or was apprised of what little good burying the wires would effect. And in his calm fashion he took a chair to make an argument or two. "I think I understand my duty as a subway commissioner," said Mr. Flower. "But—" and Mr. Gould recited a long list of objections and special pleadings. "The law says the wires are to go under ground, doesn't it?" interjected Mr. Flower. "Well?" "The law says they must go under ground. They're going." "But, Mr. Flower, the law is unconstitutional, and—" "Just let me tell you something, Mr. Gould," and Mr. Flower talked with an earnestness that wasn't to be misinterpreted, "just let me tell you one thing, and that's this: The law is going to be obeyed this time. And your telegraph wires are going under ground, even if Jay Gould and the whole Western Union crowd have to be locked up in jail for trying to interfere." "Oh, well, perhaps there's no need for us to discuss the matter," quoth Mr. Gould calmly, and he withdrew. The next day it was announced that he had come to the conclusion that perhaps the wires were best buried after all, and he had taken a big slice of stock in a conduit company.

During the official year just closed, 1,025½ miles of new miles of railways have been completed and opened for traffic in India.

The committee on fire and water, of the town of Lake View, Ill., have decided to erect fifteen police and fire alarm boxes at once.

An electric invention for heating passenger coaches has about been completed by a young man of Racine.

The melograph has been invented, by which a person can improvise on a piano and have the music recorded.

The North Side street railway company of Chicago, last week took possession of La Salle street tunnel, and will use it hereafter to the exclusion of vehicles, other than those of the cable system to be used, paying the city $25,000 a year rent.

Matthias Splitlog, who is credited with the possession of property worth $1,500,000 is probably the only Indian railway magnate in America. He is a full-blood Indian and was once chief of the powerful tribe of Wyandottes. A company has been formed known as the Kansas City & Fort Smith Railroad company, which will build as near as possible an air line from Fort Smith to Kansas City. The Wyandotte chief is the principal backer in the enterprise, and is very enthusiastic over his plans.

A romantic marriage recently took place at Starke's station, Ga. H. S. Haines, a telegraph operator at Dalton, and Miss Ella Phillips, an

operator at Sugar Valley, courted over the wires and met by appointment at Starke's station, where they were married under a big hickory tree. They went from there to Dalton, and then departed for their respective posts of duty.

The managers of the Boston & Albany, the New York, New Haven & Hartford, and the New York & New England railroads have, it is said, agreed upon the consolidation of those great properties. The ownership of the Albany and the New Haven road is in great part identical, and together the two control the majority of New York & New England stock. The New Haven company is now four-tracking its road from New York to New Haven, and it is said that the Boston & Albany will extend its four-track line from Boston to Worcester, and at the same time shorten its distance to Springfield 11½ miles.

The Economical Heat & Gas company have made an offer to the Town of Lake, Ill., to furnish illuminating power of 125 candles for $1.50 per 1,000 feet, heating gas at $1.25 per 1,000 feet, and gas for public lamps at $1.25 per 1,000 feet. President Sherwood stated that his company would light the street lamps at $22.50 per lamp where the town now pays $27.50, a saving to the town of $5,000. No action has been taken on the offer.

The prize offered by the French government of $10,000 for the most valuable discovery relating to the utilization of electricity is to be awarded next December. It is for any use or application of electricity, namely, as a source of heat, of light or of chemical action, as a means of transmission of mechanical power, or of verbal communication in any form, or, finally, as a curative agent.

Business Mention.

The buildings of the Chicago Brass company at Kenosha, Wis., are to be lighted by a Western Electric company arc light plant.

Forée Bain, of Chicago, has sold to a New York syndicate the exclusive right to sell his motors in the New England states and New York state. Negotiations are pending for the control of the entire United States by the same syndicate, in which case Cyrus Emery, of Room 25, 115 Dearborn street, Chicago, will act as general agent. Mr. Bain's motor is one that has received the most favorable commendation from electricians, and, with capital back of it, there is no reason why it should not take a leading position among those more widely known.

The city of Bath, Mo., has just entered the list of cities to be illuminated by electric light. The common council passed a vote almost unanimously, authorizing the mayor to contract for five years with the American Co. for lighting the streets. The Bath Electric Light & Power Co. has been organized, with F. A. Sawyer, president, and Fritz Twitchell, treasurer. The work has commenced, and the plant will be in operation some time during this month.

The Shelbyville Water Works Co. is another water works company which has decided to go into the electric light business and combine it with their water works. A contract was given recently by the city government for lighting the streets with the American system of electric lighting.

The local Thomson-Houston Electric company, of Jackson, Mich., recently closed a contract for 180 arc lights.

Samuel I. Pope & Co., 193 Lake street, Chicago, in connection with other work, are wiring the state house at Austin, Texas, for the electrical appliances that will be put in.

The Electrical Construction company is putting an improved Hess annunciator and fire alarm in the Hotel Richelieu, Chicago, and are wiring the town of Beaver Dam, Wis., for a Westinghouse illuminating system of 2,000 lights.

The western office of the Thomson-Houston Electric company filled orders for 444 arc lights in July, 658 arc lights in August, and September 1st found them with unfilled orders on their books for 1,645 arc lights.

J. H. Reid, western manager of the Mather Electric company, has recently returned to Chicago from a northern trip. A handsome contract he brought back with him was for a 300-light plant for Frank P. Blair's apartment house at St. Paul, Minn.

The Thomson-Houston Electric company have fixed upon Fremont, O., as the location for their plant for manufacturing carbon points. Two weeks ago they purchased what were known as the harvester works, which it is said originally cost $124,000. The main building is 96x274 feet. The steam plant is in and all is ready for immediate occupancy. The room seems ample, but if the carbon business keeps pace with the amazing growth of the company in other departments, there will have to be an expansion.

The western office of the Thomson-Houston Electric company have closed a contract for new offices and a store and repair room on Michigan avenue, Chicago, between Adams and Monroe streets. The company will have two floors, each 40x178 feet, or 13,000 feet of floor room. The building will be ready for occupancy prior to January 1st, next. A steam plant will be put in, and in addition to doing their own repairing, the company will run their own installation of lights.

The Citizens Railway company of St. Louis —a new cable car company—have ordered two cars of the Pullman Palace Car company and two of another company. Each of the cars to be furnished by the Pullman company will be lighted by eight incandescent lights from a storage battery carried on the car. A total of fifty cars will be eventually purchased and the adoption of the style of car and the method of lighting, it is understood, will depend upon the choice of the company and the results of the experiments with the two cars to be lighted in the manner indicated. Johnson, Holland & Co. will install the storage batteries.

L. P. Hanson, of Chicago, has replaced his old system with an Excelsior plant, through F. W. Horne, of 15-arc lights and ten incandescent lights from an arc light circuit. James Wild, jr., clothier, at Madison and State streets, has started up his new Excelsior plant. The automatic regulator is guaranteed to work down to one light, and save power in proportion to number of lights burning. The Excelsior Electric company, of St. Louis, are erecting a large plant of arc lights of the Excelsior system at Mt. Vernon, Ill. After a hot competition of the leading electric light companies represented in Chicago, Thos. R. Lyon, of Ludington, Mich., awarded F. W. Horne, manager of the western agency of the Excelsior company, the contract for lighting his sawmills and salt works with 45-arc lights and 100 incandescent lights. The Queen City Electric Light company, of Gadsden, Ala., has ordered a 15-light plant of the Excelsior system in addition to their thirty-six lights.

At the Minneapolis Exposition the Hill Clutch works of Cleveland, O., have an exhibit that would do credit to a much older firm. They have friction clutch pulleys driving dynamos for the purpose of lighting the building, and large friction clutch pulleys driving some of the main lines of shafting. They also have a special exhibit consisting of a line of shafting 40 feet long, equipped with friction clutch pulleys and couplings of various sizes and capacities, all of them running different kinds of heavy mill machinery. All of their clutches in the exposition are running shafting or machines, showing their excellent qualities under full condition of service. This company have fitted up a large space with desks, tables, chairs, writing materials, periodicals and a stenographer—all for the convenience of visiting manufacturers who may be at the exposition in the interest of machinery of different kinds.

Electrical Patents.

Issued September 6th, 1887.

369,320. Underground Electric Cable. John H. Dalzell, Pittsburg, Pa. The core consists of concentric groups of conductors, the shortest group being on the outside. The core is covered with lead, which is compressed to conform to the gradually diminishing diameter of the core throughout its entire length.

369,349. Electric Lamp. Osborn P. Loomis, Somerville, Mass.

369,372. Lead-Armored Conductor and Process of Making the Same. Thomas G. Turner, New York, N. Y. Lead tape is folded around the conductors so that each will be enclosed in a separate channel. The meeting faces of the tape are fused by being passed through a heated die.

369,376. Telephone. Frank C. Watkins, Philadelphia, Pa. A diaphragm of iron is placed near a second diaphragm of non-conducting, sonorous material like wood. The circuit is closed by a loose ball in a recess provided in the iron diaphragm, falling by gravity against a carbon wafer on the wooden diaphragm, whenever the telephone is held horizontally, as in holding it to the ear.

369,377. Krotophone. Frank C. Watkins, Philadelphia, Pa.

369,378. Krotophone Receiver. Frank C. Watkins, Philadelphia, Pa.

369,379. Telephone Transmitter. Frank C. Watkins, Philadelphia, Pa.

369,386. Electric Synchronizing Attachment for Clocks. Edmund F. Bard, New York, N. Y.

369,394. Electrical Conductor. Henry F. Campbell, Concord, N. H. The anti-induction shield is composed of paramagnetic material. Soft annealed iron ribbons are preferred wound on spirally on the outside of the insulating material, the edges of the ribbons overlapping.

369,400. Dynamo Electric Generator. Rudolph Eickmeyer, Yonkers, N. Y.

369,432 Electrical Heating Apparatus. Albert H. Buckelew. New Brunswick, N. J.

369,436. Lightning Arrester. Augustus B. Depuy, Camden, N. J.

369,439. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.

369,441. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J. The invention relates to a system in which high tension currents are employed, generated at a station situated at a distance from the district to be supplied. A dynamo electrical machine adapted to generate a current of high tension is situated at a place where power is available and connected by small conducting wires to one electro-dynamic motor placed at a sub-station, said motor having its armature shaft mechanically attached to the shaft of a dynamo electrical machine, the field magnets of both motor and dynamo being changed by the current from the said dynamo. A multiple circuit is supplied from the dynamo driven by the motor. The current thus serves to furnish either power or light within a limited district. Any suitable number of sub-stations may be supplied from the high tension dynamo. The patent contains sixteen claims.

369,442. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J. An electrical motor is placed in a high tension circuit which supplies converters. The speed of the motor is related manually to maintain the electro-motive force at any desired tension.

369,443. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J. Two or more systems of distribution from a high tension dynamo through the medium of converters, by means of which such systems may be joined together. Thus one source may be made to supply two or more distributing systems, or two or more sources may be connected to one distributing system, as required.

369,447. Insulator. Edwin T. Greenfield, New York, N. Y.

369,456. Electric Arc Lamp. Hermann Lemp, Hartford, Conn.

369,505. Galvanic Cell. Luis Drescher, New York, N. Y.

369,561. Apparatus for Lighting Cars by Electricity. Sidney H. Short Denver, Col.

369,568. Feed Mechanism for Arc Lamps. Willoughby W. Street, Springfield, Mass.

369,577. Printing Telegraph. William B. Wood, Jersey City, N. J.

369,592. Manufacture of Bunched Electric Cables. John H. Dalzell, Pittsburg, Pa. The article of manufacture and the process will be understood from the fourth claim, viz: "The process of manufacturing bunched electric cables, consisting in forming a number of insulated wires into a straight or spirally arranged core, then compressing the same, and, finally, compressing thereon and into the external cavities thereof a continuous seamless envelop or covering of metallic lead, substantially as described.

369,593. Bunched Electric Cable. John H. Dalzell, Pittsburg, Pa. The saturated bunched core is covered with lead, which is compressed into the external cavities thereof.

369,594. Manufacture of Diminishing Electric Cables. John H. Dalzell, Pittsburg, Pa. The invention relates to the hydraulic press for covering cores of cables with lead. See patent 369,320 above.

369,595. Magnetic Register Connection for Water Meters. Albert S. Dietzman and George Cressey, Louisville, Ky.

369,640. Arc Lamp. David J. Hauss, Cincinnati, O.

369,655. Regulator for Dynamo-Electric Machines. Edwin Place, Chicago, Ill.

369,664. Carbonized Mould for Incandescent Electric Light Filaments. Edward P. Thompson, Elizabeth, N. J.

369,665. Method of Testing Electric Light Filaments. Edward P. Thompson, Elizabeth, N. J. The carbonized filaments are tested by dividing an electric current through an independent circuit and through different sections of the filament of constant length successively, and indicating the relative values of the current traversing the two circuits.

369,666. Carbonizing Mold for Incandescent Electric Light Filaments. Edward P. Thompson, Elizabeth, N. J.

369,672. Electric Alarm Clock. Amos G. Wolley, Cincinnati, O.

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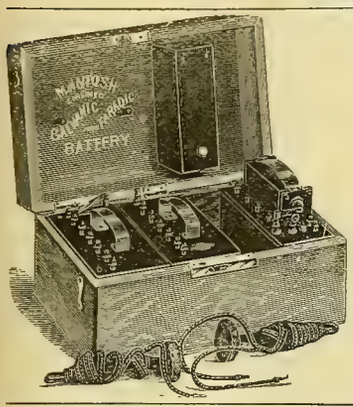

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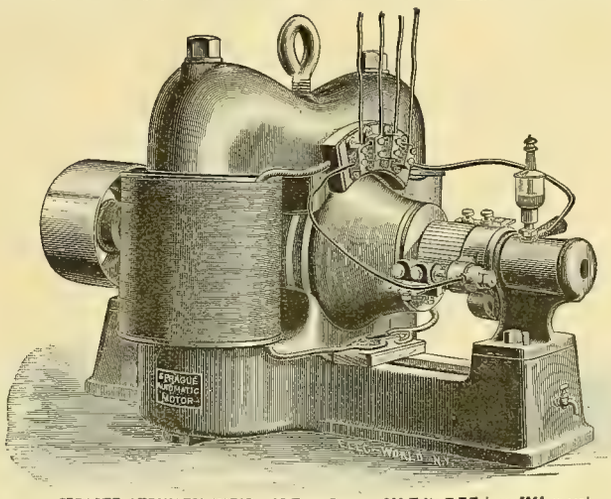

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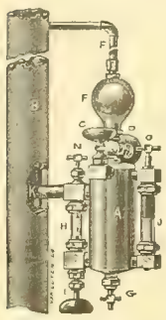

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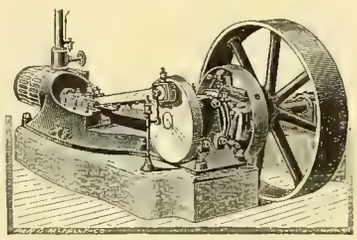

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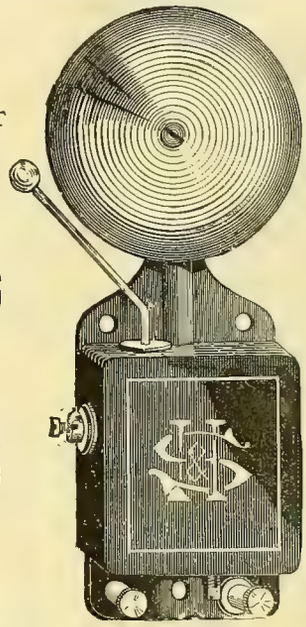

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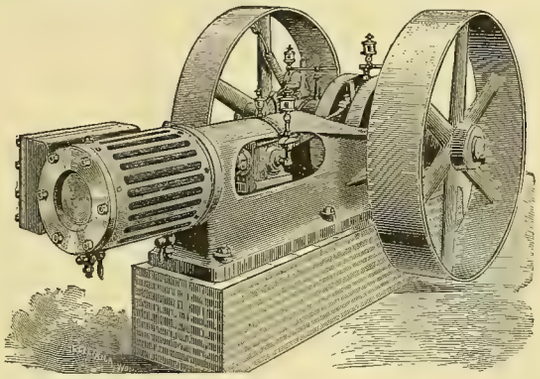

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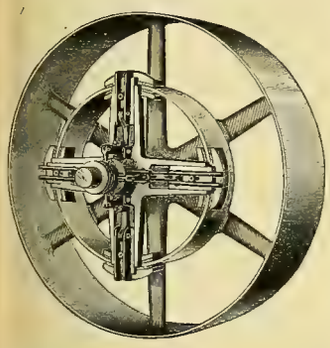

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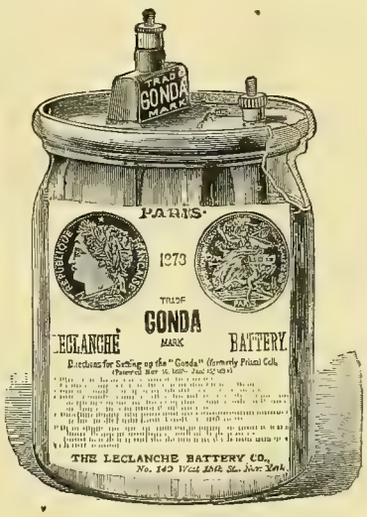

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This Exhibition will be held in the City of New York, in the American Institute Building, Second and Third Avenues, between Sixty-third and Sixty-fourth Streets, and will be OPENED TO THE PUBLIC ON SEPTEMBER 28, continuing to DECEMBER 3.

No electrical exhibition has ever been held in New York, and a rare opportunity is thus offered of bringing electrical apparatus prominently before the public of New York and vicinity. It is confidently expected that **750,000 persons will attend this Exhibition**, thus giving the same a widespread publicity.

☞ Steam power will be furnished free, and the charges for space are very moderate. Blank forms of application as well as other information relating to the Exhibition, will be furnished on application to the Secretary, JOSEPH WETZLER, Room 175 Potter Building, New York, P. O. Box 3265.

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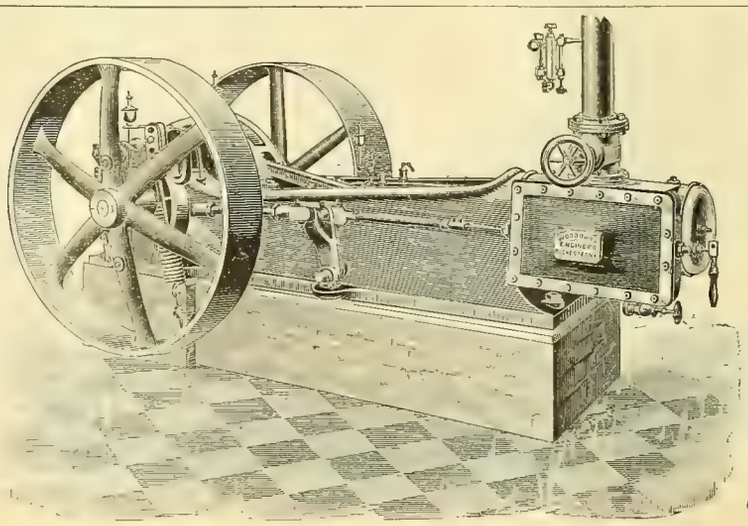

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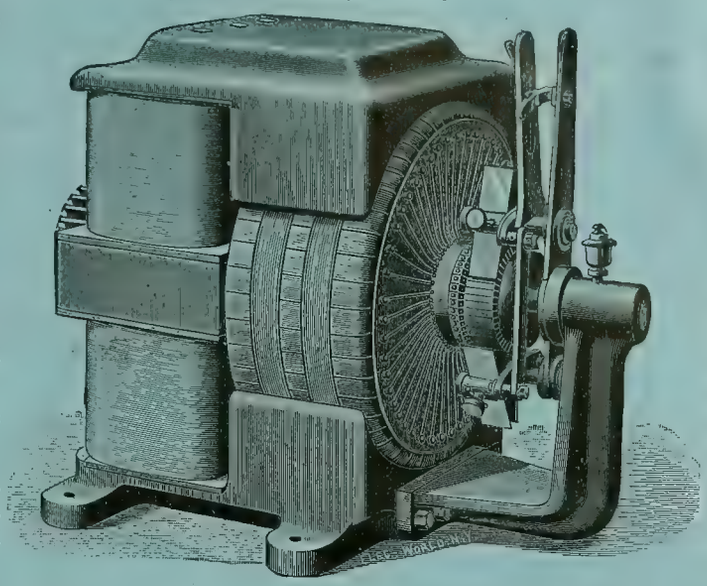

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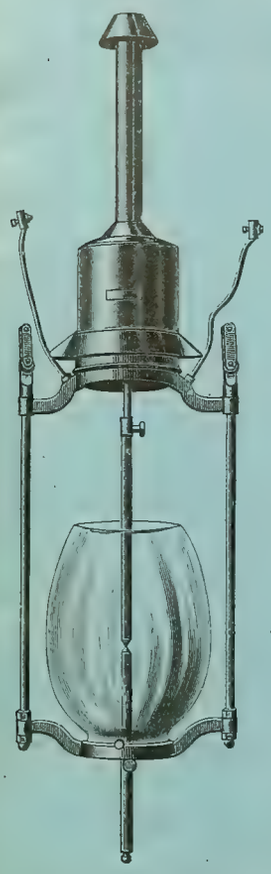

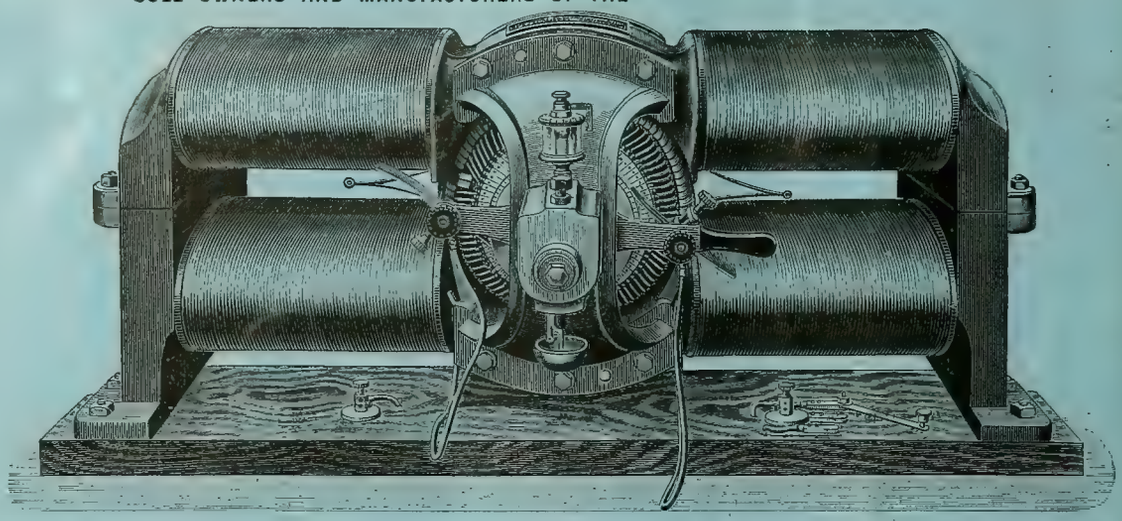

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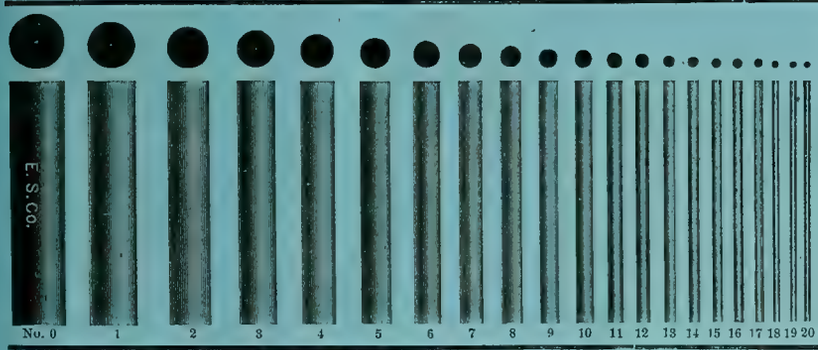

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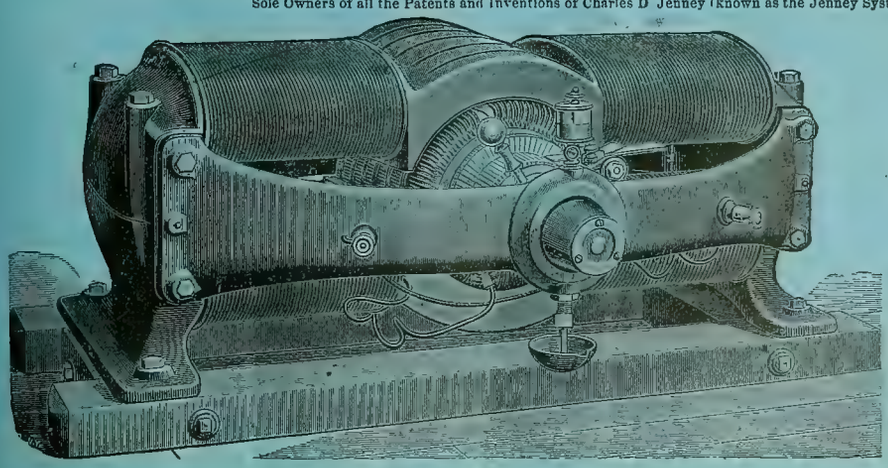

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In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

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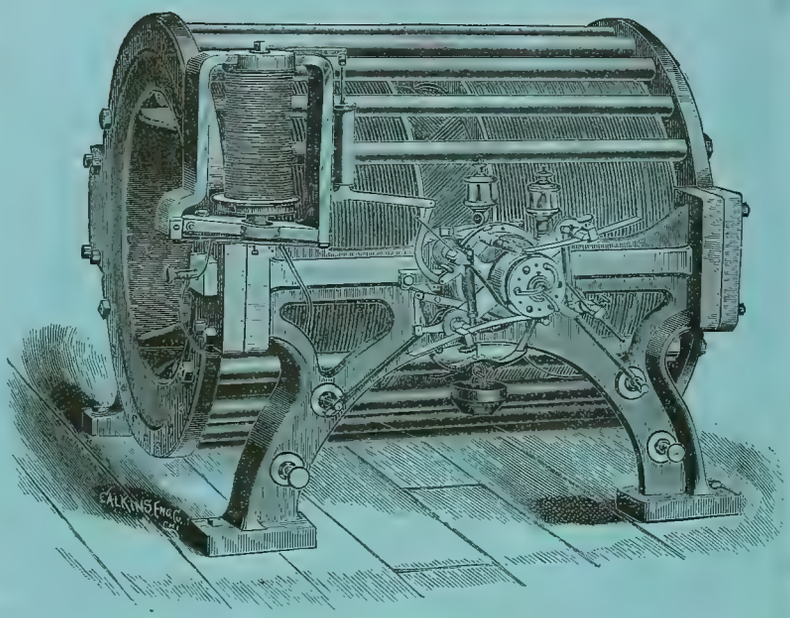
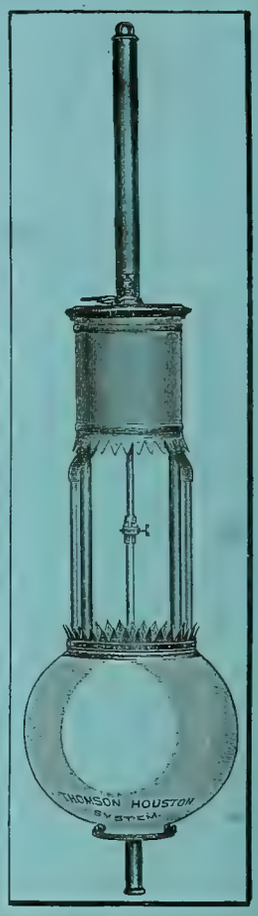


The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.



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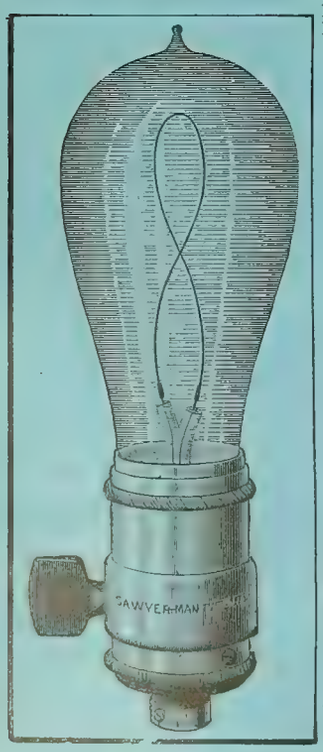

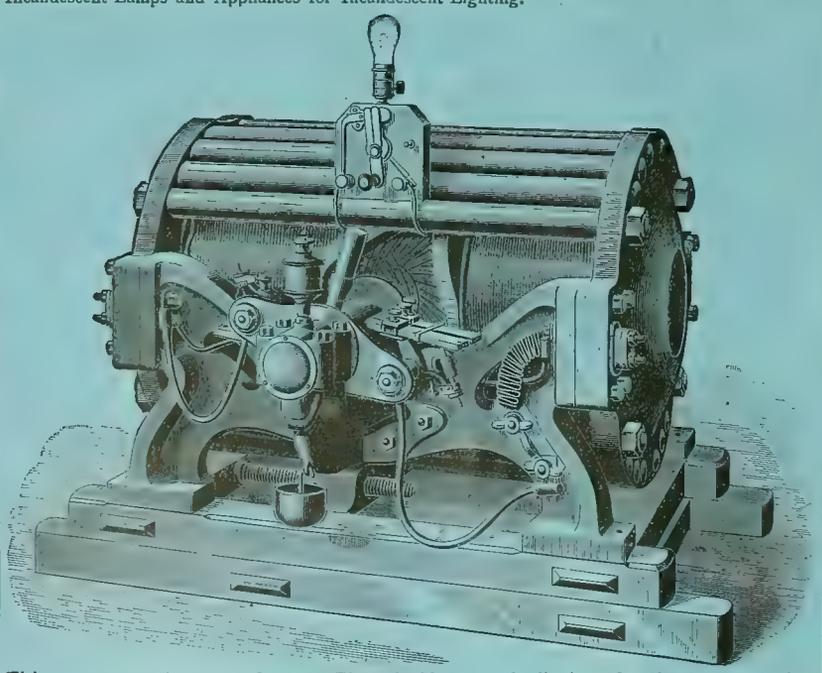

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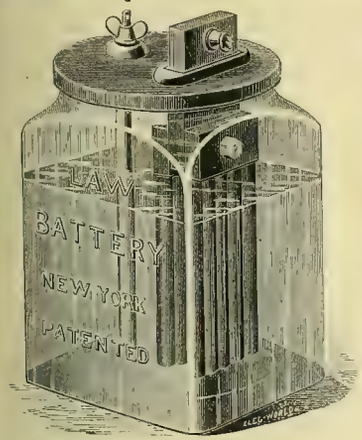

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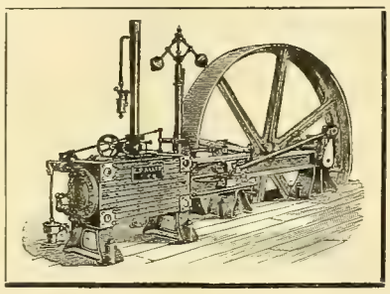

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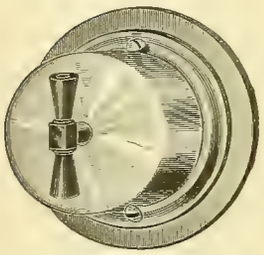

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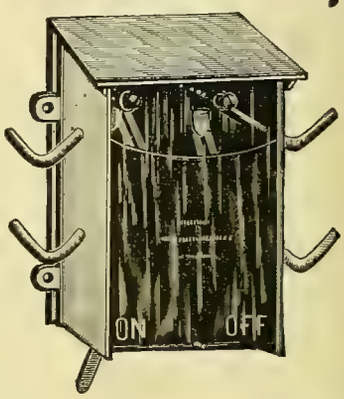

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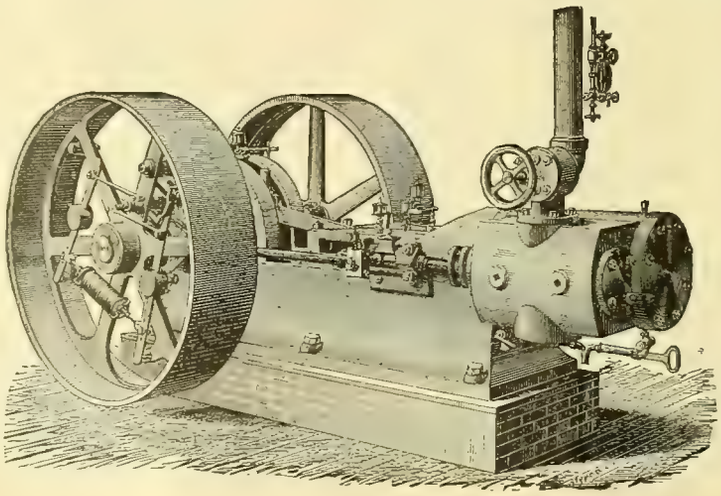

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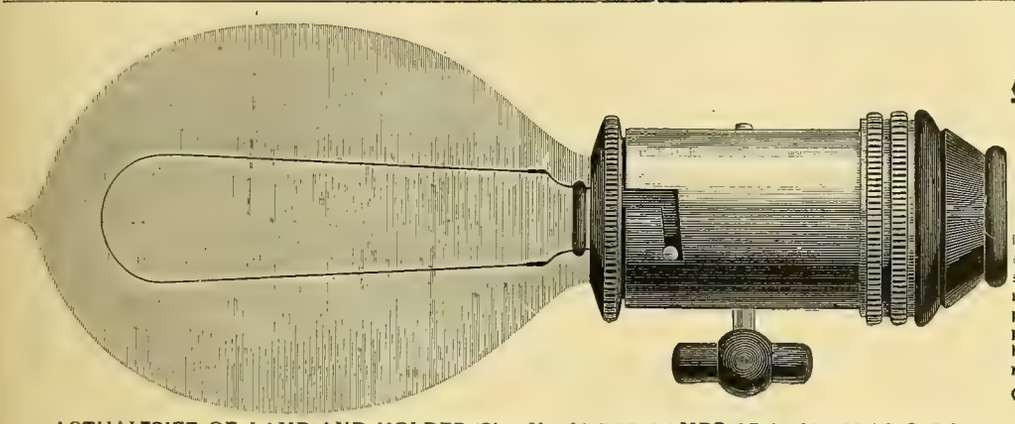

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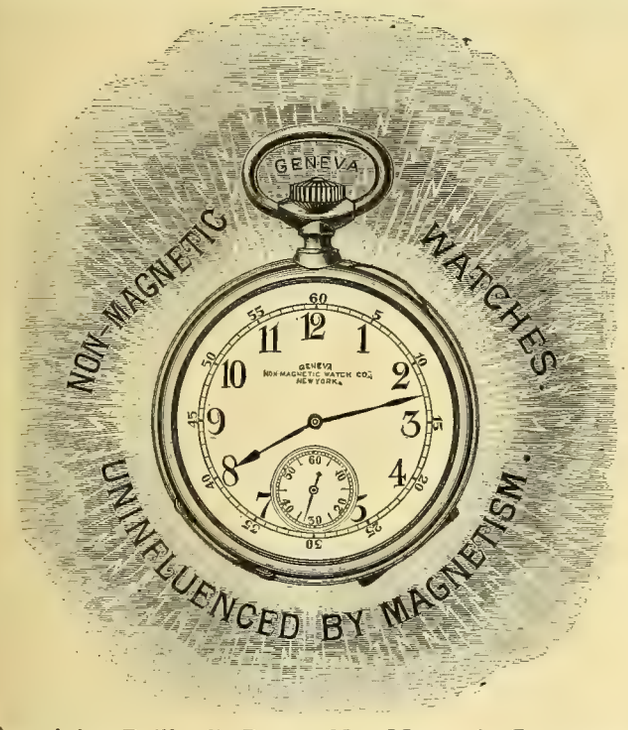

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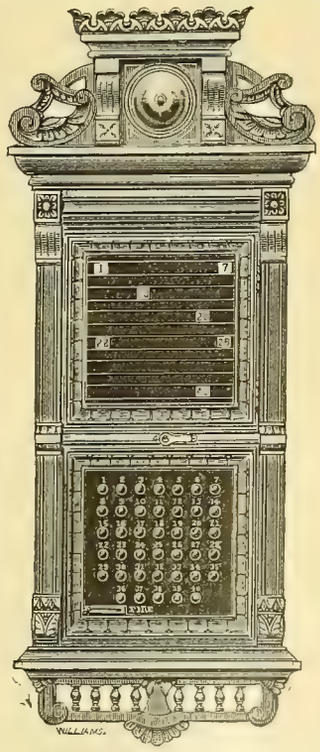

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No Discoloration of Globes.

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Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.

"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."

J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT,
THE U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously insyalled by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were burned?	348.
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 600 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C. C. Warren Esq.

Dear Sir. I have written the answers opposite your questions above as per your request, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.

Yours truly, J. F. Conklin

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, SEPTEMBER 24, 1887. No. 13.

The Chicago Induction Motor.

There has been for a long time an urgent demand for a small, efficient electric motor to run sewing machines, dental apparatus, electro-static machines, small lathes, and other light machinery, the current to be supplied by a battery or otherwise. Several such motors have been made and put on the market, but none of them have had the requisite efficiency; and, in most cases, they have proved to be a source of vexatious annoyance and useless expense. To remedy this, the McIntosh Galvanic & Faradic Battery company have recently invented the little motor shown in the cut, which, it is claimed, has no delicate devices to get out of order easily, and furnishes a maximum of power at a minimum expenditure of current. Its construction throughout is essentially the same as that of a dynamo, as shown by the cut, and it can be used as a generator, if necessary, by the application of hand or other power. The armature core is composed of thin, sheet-iron rings, built up in the usual manner, and incased in cast-iron, the combination, as claimed by the inventors, improving the magnetic effect. The wear is reduced to a minimum, the motion can be stopped, reduced, or accelerated instantaneously; and its neat finish and diminutive size adapts it to use in any position as an attachment to the machinery for which power is required. Its size, at the base, is 5x7 inches; height, 7½ inches, and weight, 16½ pounds.

Chicago Electric Club.

The attendance at the meeting of the Chicago Electric club, Monday evening, September 19th, was large and evinced the growing interest taken in the club by the members.

C. A. Brown, first vice-president, took the chair, in the absence of the president, Gen. A. K. Stiles.

Routine business was transacted and the matter of securing more eligible quarters was then thoroughly discussed. The outcome of the discussion was the appointment of a committee of three, consisting of Messrs. W. J. Buckley, W. A. Stiles and Charles D. Shain, all members of the board of managers, to select more suitable quarters.

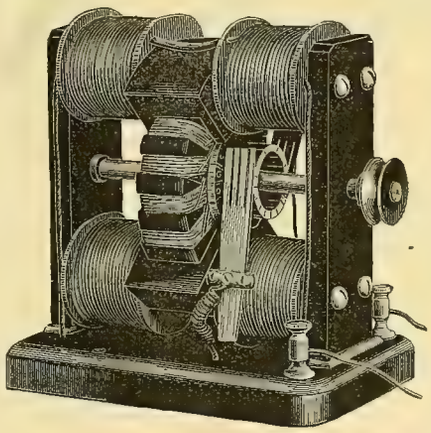
E. A. Sperry then presented his paper on "protection of dynamos from lightning," given in another place in this issue.

Professor Badt called attention to a statement in the paper that experience had shown that lines run from low tension dynamos were less liable to be struck by lightning than lines from high tension dynamos. He thought the explanation lay in the fact that circuits of low tension dynamos covered only small areas and for the most part were in large cities where they were protected by high buildings.

A. H. Brown said he had no use for lightning arresters on underground circuits, and most all of the circuits of the Chicago Arc Light and Power company were partly underground and partly aerial. He had never known of any of the circuits being struck by lightning, and if they were he thought the lightning would break through the insulation in a great many cases before it reached the dynamos. He never saw two lightning arresters that worked alike. He saw one that had been struck by lightning and it was all burned out. He saw another that had been struck three times and it scarcely showed any signs.

Professor Badt, referring to the behavior of lighting arresters cited by Mr. Brown, thought a cause could be given. He related an instance where a lightning arrester was connected to a pipe which was afterwards found to extend into dry earth only about six or eight inches. A report of a commission appointed by the German government to consider lightning and its effects had just been published and it said, quoting the speaker's translation from a copy he had in hand, "Earth is only to be considered good for a lightning arrester when a plate of at least one square meter area is put in wet earth; but that is not sufficient; if a gas or water pipe is near to it, connect the arrester to that also." The systems, he said, should be connected. The connection of the ground wire to a water or gas pipe is by no means a substitute for the earth plate, the latter should be there at all events, and every time a lightning arrester is put in use it should be connected in the manner outlined.

Mr. Andrews said that the first lightning arrester he used was suggested by Mr. Edison. During a thunder storm the engineer in a station was



to connect the wires of the three-wire system to ground, to an iron wire resistance of about 100 ohms. Practice showed this to be of but little use. Sometime ago a patent barb wire fence arrester was invented, but he understood this was almost useless. "Up to the present time we have no thoroughly reliable lightning arrester, and the only thing I can see is some device similar to the arrester shown."

E. R. Warner related an incident where he set up a dynamo and connected the lightning arrester to a steam pipe which he supposed would give him a ground. During the evening in a storm there were a number of discharges of lightning, and next day he found that the resistance to the ground was about 500 ohms. "We have had dynamos damaged by lightning;" said the speaker, "the discharge passed through the insulation of the field magnet wire to the core but did not pass to the ground, the dynamo being perfectly insulated from the ground." He thought, therefore, that while a good ground was very desirable, that a large bulk or mass of metal connected to the lightning plate, even if thoroughly insulated from the ground, would serve as a great measure of protection.

Mr. Andrews added that he had heard that a great mass of metal would distribute the charge of lightning. He knew of connections to the core of Edison dynamos being made in precisely the same manner described by Mr. Warner, and it was extremely rare when damage was done to any other part than the field magnet.

B. E. Sunny, of the Chicago Telephone company, said that eight or nine years ago he saw a manager of a telephone exchange making some experiments, and he noticed that the manager had made his ground connection to the leg of a stove. Mr. Sunny refrained from "poking any fun at him," though he enjoyed a laugh in secret, nevertheless. From what he had heard this evening, he thought he ought to call upon that manager and apologize. Up to about four or five years ago the telephone company had been troubled in every storm by drops in annunciators being burned out by lightning. At that time they had between four and five hundred telephones in use; now they have between 4,500 and 5,000 telephones in use and the trouble has almost entirely ceased, except on lines in the country. The company attributed the decrease of the trouble to the increase in the number of wires which served to dissipate the charges of lightning.

F. J. Sprague, of the Sprague Electric Railway and Motor company, a welcome guest of the club, was called upon and said that they had very little use for lightning arresters on motor lines.

H. McL. Harding, of the same company, upon request, addressed the club, and after referring briefly to lightning arresters, spoke of recent achievements in the motor line. His remarks were greeted with applause.

H. Ward Leonard stated that at Appleton, Wis., where the Edison company has a plant run by water power, there formerly prevailed severe thunder storms. Since the extension of the wires of the company, an old resident had complained that the city was losing its reputation for the severity of its thunder storms, and Mr. Leonard happily suggested that perhaps the decrease in the severity was to be ascribed to the extension of the wires of the electric light plant.

Among other speakers, whose brief remarks, questions and suggestions brought out much of the discussion, were: Messrs. Haskins, Bliss, Buckley and Stewart.

On motion of Mr. Buckley, a vote of thanks was tendered Mr. Sperry for his paper.

The next meeting of the club will be held Monday, October 3rd.

Protection of Dynamos from Lightning[1].

By Elmer A. Sperry.

Owing to the extensive use of dynamo electric machines at the present time, their protetion from the effects of lightning is a matter of great importance. The subject is especially interesting, inasmuch as it involves the mysterious movements of atmospheric electricity. In connection with this subject, it will not be out of place to consider the action and effect of this phenomenon.

When a cloud becomes charged, either from the direct energy of the wind, change in temperature, or from any cause, the charge is gradual, though it is of a great absolute potential. The earth and all bodies connected with it are, through induction, of opposite polarity, or acquire an opposite potential, in the same manner that the coatings of a Leyden jar become oppositely charged when one coating only is connected with the prime conductor of a so-called static machine. When a discharge takes place, there is an instantaneous change of potential

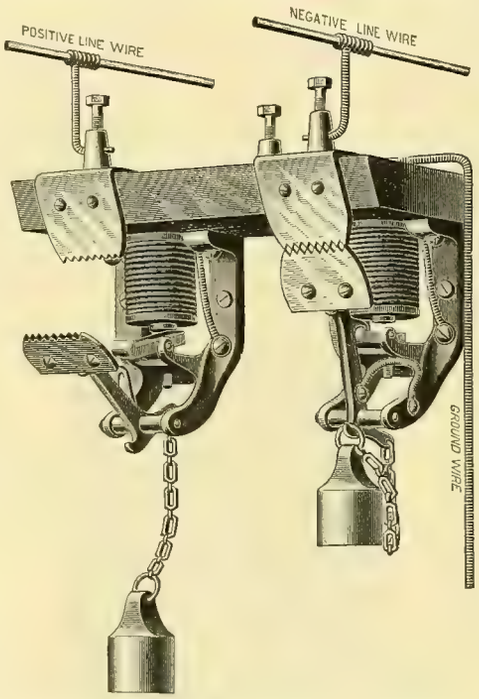
[1]Read before the Chicago Electric Club, September 19th.

through an immense range. After the discharge, the potential of the surfaces, which were sustained at great difference, is found to be equal or nearly so. On the earth, at the moment of a discharge from a cloud, there are, doubtless, large tidal currents of electricity of momentary duration which attend the distribution of this change of potential, whereby the entire surface or mass is equalized as to absolute potential. The disruptive discharges between the earth and the cloud, by means of which the potential is satisfied, takes place sometimes in one direction, —that is, from the cloud to the earth—and sometimes in the other direction, the "flash" issuing upwards from the earth.

In telegraph lines, where the earth is used as part of the conductor, these instantaneous currents, in their rush to harmonize the potentials of the line and the earth, are of such great magnitude that a startling explosion is produced in the relay where a small conductor, and also the retardation produced by the lines of force thrown out by the cores of the relay magnets are encountered. This retardation effect may be considered as a reciprocal of the extra-current effect and plays a very important part in connection with the damage done to dynamos in consequence of these discharges. When the sound is heard the operator says his line "is struck," or the line is discharged, but this so-called discharge may indicate exactly the opposite phenomenon, the line actually receiving a charge. It is, however, a convenient phrase and will be used here to express the current resulting from instantaneous discharges of atmospheric potentials. The telephone line operates in the same manner, and when it consists of long aerial lines it shows another form of current produced by atmospheric action, manifesting itself in a fitful flow of current between the line and the earth. These currents may be induced or developed upon the line, by the action of the wind. This gradual discharge occurs, to a very limited degree, upon electric light lines, and is of little importance, owing to both the high conductivity of such line and to resistance met by the discharge on its passage to the ground. This resistance should be high when the lines are in their normal condition. It is only to the sudden changes in potential that any great harm can be traced. These sudden changes, therefore, deserve special attention. An electric light line, if it was insulated from the ground entirely, would receive its potential wholly through induction, and no current could circulate unless the line was long enough, or of such a character to admit of one portion being more strongly acted upon by a potential wave than another; but the word insulation must be considered as a relative term. When speaking of the immense potential which we have to consider in connection with atmospheric phenomena, that which would ordinarily be considered a good insulator must be regarded as a fair conductor; and one megohm which satisfies the requirements of the ground insulation in electric light lines offers a comparatively slight obstacle to the passage of currents produced by these extreme atmospheric potentials. Think of the immense resistance offered by sixty feet of dry cedar; yet even through such a medium a considerable current is induced to flow, as in the case of "St. Elmo's fire" so often observed at sea.

It will be seen from this that an ordinary electric light line is a part of the earth's surface, so far as the distribution of the potentials of the earth is concerned. The distribution upon such a line is found to follow the same general law governing grounded lines.

In this connection it will be found that an arc light circuit differs from an incandescent light circuit in two ways: First, the currents due to a change of potential in the incandescent system, will occur more by way of distribution of this potential throughout the line, owing to its large mass and far-reaching branches. This generally produces a fluctuation in the candle power of the lamps. Second, owing to the immense surface exposed and the relative low resistance to the ground required in such a system, the resulting current does not necessarily run in upon the dynamo, but finds numerous points of escape to the ground, being equally distributed upon the line as above pointed out. The fixtures generally offer many points of low resistance to a direct ground. The arc line, owing to the high potential used, has a high insulation from the ground and a very small service compared to that of the dynamo, which offers the greatest superficial area for ready passage to the ground. We should therefore expect to find more trouble with arc than with incandescent dynamos from lightning. By incandescent dynamos, I mean those generating comparatively low potential, up to say 220 volts. On a dynamo the wire comes in close proximity to the iron cores and body of the machine. In the armature, the proximity referred to is usually closer than in any other part of the machine. The base of the machine and the iron parts offer a larger surface to connect the system with the earth than at any other point. Therefore, when these instantaneous differences of potential arise between the earth and the line, which exist before the line potential has been satisfied, instantaneous currents of tremendous magnitude circulate in a direction toward or from the area of weakest ground insulation, encountering in their passage the small conductor in the dynamo, and the retardative effect of the lines of force thrown out by the magnets. In the armature, the core of which



is generally so finely divided that the magnet potential can rise, and keep pace in some degree even to these instantaneous discharges, the retardation is especially noticeable. The effect of this is to break through the insulation to the iron core of the armature generally at two opposite points coinciding with the points then in direct connection with the commutator brushes. Armatures thus short-circuited often burn out and a contact to the metal frame is sometimes broken through at some other point previously weak, and the machine is thereby crippled. The field, especially where it consists of any particular mass of metal, is not affected directly to any appreciable extent. For the foregoing reason we would expect to find the greatest trouble in the armature, and this is borne out by practical experience. That incandescent dynamos are not as much exposed to the dangers named, is also a fact, as shown by experience.

The methods of preventing damage arising from these currents are numerous. Upon aerial grounded lines, the lightning-arrester, as it is called, is often made by placing two surfaces close to each other, and separated by very thin mica, one surface being connected with the line, and the other with the ground, a large difference of potential operating to discharge through the mica, and generally burning and fusing the surfaces into contact. Another form is that of two rows of small teeth set opposite each other, each forming an edge of the two plates, connected as above, and the potential jumping across the small intervening space between the teeth, forming an arc through which the discharge takes place. In arc light circuits, the same devices have been resorted to with considerable degree of success. The difficulty, however, arising from their use, is that the arc established between the surfaces operates to short circuit the dynamo upon which they are used, for the reason that a pair of these surfaces are used, one being upon each limb of the circuit. This difficulty has been overcome to some extent by using fuses upon the ground circuits which are designed to melt at a current not much exceeding the normal current of the dynamo. When so used, the fuse must be very long, and even then there is danger of fire resulting from the arc so produced. Fuses upon the main line are better adapted to incandescent than to arc systems, for the reason that after the main circuit has been severed, by the fusing of these strips, the remaining potential may create currents which will escape to the ground by other means, such as through the supporting fixtures of arc lamps, or through the weakest insulation in the line, doing damage in some cases more difficult to repair than if the potential were allowed to dissipate itself through the large area afforded by the machine. Another method has been used in connection with incandescent systems. It consists of stringing a grounded line on the top of the poles immediately over the system of wiring, which independent wire is supplied with numerous points. In practice, the wire consists of a piece of barb-wire fencing. When there is an instantaneous change of potential of great magnitude between the system of wiring and the earth, this method is not found to be efficient, inasmuch as the line is not thereby instantly relieved. The line is, however, protected from a direct discharge by the ground wire which offers a more direct path.

Automatic devices to be used upon the lines of an electric lighting system have been devised whereby the currents due to static charge may be taken off from the system without the insulation being injured, and also without the other inconveniences pointed out above. The devices referred to are of two classes. They have, in common, this feature, namely, means for rupturing or extinguishing the arc formed by the discharge. The first class consists of an apparatus in which this active element operates continually while the current flows in the main line; for example, an electro-magnet in the main circuit, constantly energized; the second class, where the magnet is in the ground circuit, and is, therefore, energized only at the instant of a passage of current between the line and ground. In instruments forming the first class a very ingenious arrangement is used. It is well known that a blast of air may be so applied to a voltaic arc as to sever or extinguish it. Similar action of a magnet upon the arc has been known since the first of the present century. The lightning arrester of Professor Thompson is the first recorded application of this principle to commercial purposes, and may be described as follows: Two plates, with receding edges, one connected to the line and the other to the earth, are near enough to each other at the bottom to allow the spark to pass. Near this slot and upon its opposite sides are the polar extensions of an electro-magnet, which is included in the main circuit, and is, therefore, constantly energized, and which serves to extinguish the arc by means of the so-called magnetic blast. A pneumatic blast, serving a like purpose, is shown in a patent to the same inventor, but no record of its operation is at hand. To lightning arresters of this class there is this serious objection: They are not economical. They require an expenditure of energy for their maintenance, and there being two of these instruments upon each line, this expenditure amounts to more in time than at first thought might appear. In adapting this apparatus to his incandescent system, Professor Thompson provides an additional opening which the potential is required to span before a discharge can take place. In the second class, the contrivances, which are purely mechanical, operate to separate the surfaces between which the arc of discharge occurs, and the arc is thereby severed. After this has taken place, it further operates to automatically replace the plates ready to intercept another discharge. Apparatus of this class designed for telegraph purposes is provided with a repeating system requiring atten-

tion only occasionally for winding. In the ordinary instrument it is found preferable to replace a weight after a discharge has taken place, thereby securing the attention which apparatus of this class should have, and which the repeating instrument is compelled to do without. One design is now before you, and may be briefly described as follows: (See Fig.) The two lower plates are connected to the ground by way of the coils and a common binding post at the rear of the instrument. The armatures of the magnets serve to retain the plates and arms in their upper position, but when attracted, release them and allow them to swing down, until a weight, seen at the bottom, disengages itself, and, by falling, replaces the plates and arms attached. In some of the stations where this instrument has been adopted, a bell or gong is suitably located under the instrument, to be sounded by the falling weight, and thereby summon an attendant. Where the instrument is so located as to be plainly visible, this is not necessary. One instrument serves for both limbs of the circuit. The upper plates being merely tapped to each line, there is no circuit through the apparatus, and therefore no energy is being constantly wasted in order to maintain it. Another important advantage which this apparatus possesses is that it is always ready to operate, even when the plant is idle and no current is circulating in the line wires.

Edison's Projects.

"It is said that you have purchased forty acres of land in Montclair," said a New York reporter to Thomas A. Edison. "Is that so?"

"That is not so," replied Mr. Edison. "I have been trying to purchase land, but the prices are too high. It is surprising how the price of land goes up as soon as you want to buy it."

"Have you given up the idea, then, of buying more land?" the reporter shouted.

"Oh, no," replied the electrician. "I intend to go nearer Newark. I think it will be handier for me to have it down that way."

"What do you propose to do with the land?"

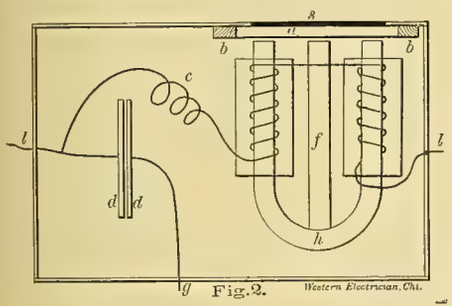


Fig. 2.

"I intend to build a large chemical works, to occupy about twenty-five acres. They will be about three times as large as my laboratory, which I am now building down in West Orange."

"Have you been making new discoveries in the chemical line?"

"Oh, yes, I have made a number of important ones; but it would not do to mention them just now. There are too many in the business. I want to get these discoveries into a commercial shape first."

"How about your project of converting heat into electricity, and making it possible to light a house by the electricity taken from a furnace?"

"I am still working on that. All my experiments thus far have been successful. The only trouble now is that it costs so much money. I am endeavoring now to fix it so that it will be cheap. I think it will go into general use some day, and that people will find it as cheap as any other process of lighting."

"Are you still working on your sea telephone?"

"I am doing nothing on that at present. I can only work on that down in Florida."

"When do you expect your new laboratory completed?"

"I calculate on having it entirely finished by Nov. 15th. I intend only to carry on my experiments there. I will employ in it about forty men. I am now engaged in working day and night on catalogues of apparatus, instruments, and so forth, that I will have to use. Nobody can do this work for me, and nearly every night I am at work until one and two o'clock in the morning arranging the schedules and other details."

Talking Boxes That Talked.

An interesting phase of the prolonged litigation between the American Bell Telephone company and the American Cushman Telephone company, was developed on the 17th inst. near Chicago. In the gray dawn of the cool, crisp September morn, an aggregation of legal and expert electrical talent, rarely seen outside a well appointed lawyer's office or the purlieus of a court room, could have been observed taking ocular and oral evidence under most extraordinary circumstances. There was R. T. Roberts, of Boston, the keen legal representative of the Bell corporation; Professor Charles H. Cross, of Bos-

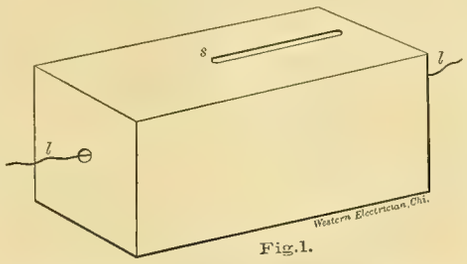


Fig. 1.

ton, whose name is known America over; Judge Smith, of Chicago, the active, clear-headed and quick acting attorney of the Cushman company; Attorney West, of West & Bond, Chicago lawyers who attend to the Bell interests in this section; L. D. Parker, of Chicago, superintendent of the Postal Telegraph company, and who is also interested in the Cushman telephone; Mr. Hotchkiss, secretary of the Cushman company; L. O. McPherson, now with Professor Elisha Gray, and other experts. There were stenographers, too, with lightning pencils, ready to make record in case their services were needed.

The purpose of the meeting at the unusual hour and place necessitates a preface of some length, and involves, to a limited degree, a narrative of Dr. Cushman's accidental discovery of his "talking boxes," concerning which much testimony has been taken at different times here and there for many months. This is the story told of the discovery:

Sometime in 1852 Dr. Cushman constructed a telegraph line from Racine, Wis., across the country northwest. In those days considerable annoyance was experienced from lightning, which would burn out the magnet coils of the instruments. At that time this was more of a misfortune than it would be now, as they were then so far removed from a place where repairs could be made, and express companies did not make as prompt deliveries as they do now. The doctor concluded that it would be just the thing to catch the lightning by some means and carry it to the ground before it could get to the telegraph instruments and damage them. Therefore, by aid of blacksmiths, cobblers and carpenters he constructed that part of the box shown in the sketch, Fig. 2, bearing the reference letters *l*, *d*, *d*, *g* and *c*, which have meanings as follows: *l*, line wire; *d*, *d*, copper disks; *g*, ground wire; and *c*, a coil of fine wire inserted in the main wire and carried on to the instruments. This part of Fig. 2 was the doctor's improved lightning arrester, and in it telegraph men will recognize the familiar disk lightning arrester which is to this day used on telegraph switch boards, and electric light men will recognize the fusible safety catch used with every incandescent lamp in circuit. The doctor's idea was that when the lightning came in on the line, the difference of potential being so great, the discharge would jump from the disk connected with the main line to the disk in close proximity connected to the ground wire, and thence to the ground; but should it, or a portion of it, fail in this, it would burn the little coil of fine wire placed in the main circuit for the purpose, and thus open the circuit and save the register or relay magnets of the telegraph instruments from destruction. After placing these "boxes," as he called them, in circuit, the trouble from lightning ceased, but whether from a streak of luck, a mere coincidence, or whether the boxes were actually doing the work the doctor expected of them, was the question which greatly disturbed him. He, therefore, conceived a "machine" which he could add to the arrester and which would act as a tell-tale on the lightning He put into the box a large horseshoe electro-magnet of soft iron, *h*, Fig. 2, and which for the purposes of the trial noted below was made of 6"x¾" round iron. Connected to the horseshoe at the yoke or neutral point, he placed a steel magnet, *f*, Fig. 2, its upper end being in line with the upper ends of the electro-magnet tines. The coils were included in the main line. Over these three magnets he placed a very thin piece of sheet-iron, *a*,—supported to the cover of the box by intermediate pieces of wood, *b*, *b*,—almost yet not quite touching them. In this position the diaphragm remained until the coils became supercharged, as by lightning, when the diaphragm or strip of iron would be drawn down on to and in contact with the magnet and "freeze" to the permanent and electro-magnets. After the lightning had left for parts unknown, the diaphragm would remain in this position until removed by a severe pull or heavy jar. The diaphragm or strip of iron served as an armature to close the magnetic circuit, which, being supercharged by the lightning, so remained until the magnetic circuit became broken and the magnetic potential again reduced to normal. The permanent magnet assisted the electro-magnets and enabled them to retain the super-charges as described. When the strip of iron was found down tight on the magnets, the doctor knew that his arrester had done its work. Observations were made through the slot *s*, Figs. 1 and 2. In theory and in construction this tell-tale of the doctor's lightning arrester, was a telephone receiver, and it was found that this instrument, clumsy and rude as it was, actually transmitted sounds, and, as claimed, audible speech.

Dr. Cushman subsequently made with more pains other boxes exactly the same in principle as the first, but of better construction. One of these instruments is shown in the sketch, Fig. 3. He substituted for the horseshoe magnet the

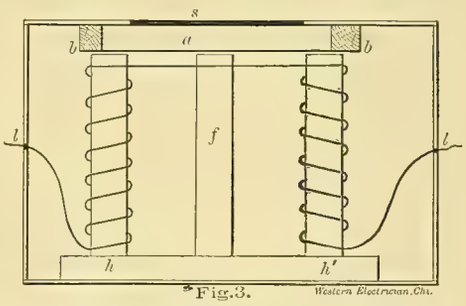


Fig. 3.

magnets of a register shown at *h* and *h'*, but the principle remained the same, and in both cases the coils were wound toward the left.

These "talking boxes" have been known in the evidence in the case as the "lightning arrester talking box" and the "register talking box." To rebut expert testimony that such boxes as had been described in evidence could not transmit speech over a telegraph line six miles in length, the trial of a week ago Friday was made. At a suburb of Chicago called Montrose, one of the boxes was stationed, and at a point between seven and eight miles distant the other box was placed. One of the boxes was of the lightning arrester style, and the other box was of the register style. A wire of the Postal Telegraph company was used and perforce at a time—between five o'clock and half past seven o'clock in the morning—when the test could be made without conflicting with the use of the wire for business. Furthermore, the place was chosen on account of its freedom from the noise of the city, and as well a freedom from induction from other wires. Questions were asked and answered from one point to the other, and conversation was carried on. The lack of means of adjustment in the crude instruments, interfered to some extent with the success of the trial, but there seems no doubt that the attempt of the Cushman company to rebut the evidence that the boxes were incapable of transmitting speech was successful, and that the boxes would and did transmit speech.

Proper Insulation and Installation.[1]

By Prof. J. P. Barrett.

It was my pleasure to appear before you at the last meeting of this association, and present my views on the dangers arising from electric light wires and the underground system. What I shall offer on the present occasion, must, to a certain extent, savor somewhat of repetition, but we must not forget that it is the long continued droppings that wear away the stone. Within the year past there has been permanent as well as rapid advancement in the right direction in the handling of electric light and other wires. This change has resulted, as I believe, from two causes. The insurance people, hand in hand with their best friends, the firemen, have made it uncomfortably warm for the electric light people, and set them thinking out some cause for this higher temperature, and seeking some method of extinguishing the blaze. Then, too, every twelve months there is a balancing of the books and a rendering of accounts, which has been showing that thousands of dollars have been thrown away by economizing in construction—a good illustration of saving at the spigot and wasting at the bung. The electric light people, like the hotel keepers, are not doing business for their health; and when the capitalist looks over his balance sheet at the end of the year, and finds that he has made no money, it is but natural that he should ask why this is so? The answer is too often found in cheap methods of construction, under a false idea of economy which the company has been induced to adopt. In the earlier days of this business, cheap installations were the rule, while to-day, perhaps not the exception, the average is several degrees better. Better or worse construction, means less or more danger from electricity; safety is true economy. This much the electric light people will acknowledge to-day, which—at least by action, which sometimes speaks louder than words—a couple of years ago they flatly denied.

In February a paper entitled "For High Insulation," was read by Mr. C. C. Haskins, before the National Electric Light association at Philadelphia, which it was more than half expected, would not be well received; yet the result of that paper, which was generously applauded, was to materially advance the cause of protection for both life and property. In that paper reference was made to the underwriter wire which has hitherto been used very largely for all sorts and kinds of outside and inside installations. This wire is probably one of the most mischief-making elements in the businesss. The insurance people at the outset demanded wire with a fire-proof insulation. That was some years ago. The wire was produced, and consisted of an insulation made of cotton braid, painted with white lead. A covering of that nature was, of course, far from inflammable, and when dry was an insulator. It was accepted, and when the sharp individual who manufactured the article, saw the advantage which would arise from a proper christening, he called it "underwriters' wire." The name has sold hundred of tons, and those tons have cost—heaven only knows how many dollars per pound, in fire losses. I am the more elaborate on this question of painted wire, because in every city that is presented here, that abomination is carrying electric currents to-day. You all know what is meant by an insulator or an insulating substance. It is any substance or material which refuses more or less perfectly to carry an electric current, and a conductor is precisely the reverse to this. Then there is a class of substances which, under some circumstance, refuse to carry electric current, while under others they will carry the current as readily almost as the wire itself. One of these substances is cotton—raw, spun or woven. When dry it is a good sufficient insulator. It is quite difficult to force it to convey electricity; so of nearly all fibers, wool, silk, or hair. Now, if we wet it—merely dampen it—it becomes a conductor. The wetting has done this. The water, in reality is the conductor, but the cotton string, or cloth, or braid—it is all the same—holds the water, and the conductor is there. This so-called underwriters' wire--sometimes called undertakers' wire for variety—is, as I have said, cotton-covered, braided, and soaked with white paint. It is not waterproof, and when dampened, will carry electricity of even very low pressure without difficulty. Here is an experiment made by I. N. Miller, of Cincinnati, Ohio. He says: "Careful experiments made by immersing twelve inches of this wire in a 6x8 jar filled with water, the ends extending above the jar so that the water could come in contact with the covering only, shows the following insulating properties:

"After one minute's time the resistance was 11,500 ohms.

"After three minutes' time the resistance was 4,170 ohms.

"After five minutes' time the resistance was 1,770 ohms.

"After one hour the resistance was 280 ohms."

One hundred cells were used in making the test, one pole of the battery being connected with the water in the jar, the other pole with the copper conductor. An ohm is a measure of resistance, of obstruction, the same as a pound may be applied to measure friction resistance. It is something to overcome by current. What Miller was doing was showing how much resistance to the passage of a current of one hundred volts—the output of one hundred cells of battery—there was in that underwriters' insulation. He reduced it from 11,500 units to 280 units, with one hour's soaking But this one hundred volts of pressure is the equivalent of only two arc lights, for arc lamps require fifty volts of pressure per lamp, as a rule.

Suppose then this wire had been tested with, say a 60 lamp current, or 3,000 volts, instead of 100, what would have been the result? So much for underwriters wire. I have spoken of it as white wire. Its reputation has so far deteriorated that the manufacturers have put some of it on the market colored black. Look sharp for it, white or black, wherever it comes in contact with moisture, it becomes a wolf. For inside purposes, above the level of cellar moisture, where there is neither leak nor steam, the underwriters' wire will do good service on proper insulation, but it will bear watching. The dangers from such electric wires, where these are run in a go-as-you-please sort of way over houses, on poles, fences, pretty much every place where they should not be, as these are quite often placed, can not be over-estimated or too thoroughly corrected. They are a constant menace to life and property. They are liable at any time to become crossed or grounded on wires, one if not both ends of which run to ground. The grounded end of the line may be a mile or more away in a dwelling. It may be in a mill that is not running at night, and it may not be anywhere to endanger property. Simply because the fates have bestowed a favorable condition of affairs for years, that is no guarantee for the future. Prevention is always better than cure, it costs less, and leaves the constitution in a better condition.

Right in this line of thought, and in this connection, let me give you a few facts by way of holding this matter down on a solid foundation. Early in the year I took pains to address a circular asking a particular class of information from the authorities in most of our principal cities. I wanted to know direct from those who knew something about the fires and personal dangers of electricity. In several instances no answers were received, and the statistics are, therefore, incomplete.

The tabulated aggregate of what I did receive shows that there have been 137 fires, with a total loss of $1,165,336. Accidents seven, deaths forty. Far be it from me to set up my voice against so popular and so necessary an element of industry as the power we derive from the dynamo. It would be foolish, even were I capable of stemming the tide. It has come to stay. It is capable of subjection and training, and this is being done by the inventors and constructors of machines and those who are making its applications for lighting and for power a study. Its danger lies in the careless handling of a force which, like other great agents of usefulness, may be as potent for evil as for good in bad hands or badly handled. How to curb and bridle this force is what we are endeavoring to find out. We want some reasonable, thorough method of warding off threatening dangers, and at the same time, of correcting faults which have existed until they may have become gray-headed.

I am one of those who do not believe that gray hairs are to be honored simply because they are gray. Age is not always to be respected simply because it is here. So I say, let us endeavor to do away with anything gray in this wire business, which has nothing on which to base its claim to respect save its tottering steps and its silvered head. You ask, "How will you do this? How are we to accomplish the result desired, and make our electric light people take such precautions as will insure our lives and the property we have the care of, from the dangers which beset us, from their poor installations?" I answer in a word: Insulate them. Place them electrically and mechanically where they can do no harm. How to arrive at that result must depend upon local legislation. Join hands with the insurance interests, appeal to law-makers, to your aldermen, your councilmen, your selectment, your commissioners, whatever the law-making body may be. You will find plenty of encouragement from the property owners, who depend on you in cold weather emergencies—men who have property to lose; these will aid you in obtaining the proper law to restrain the lawless methods heretofore practiced. It is quite the fashion everywhere to do this, and you will not find yourselves out of style. What you demand in your ordinance or regulation should be well considered and digested before presentation. There is nothing like having such an act far-reaching and thorough, and it is not at all comforting to feel, after an act has been passed, that an essential point has been omitted. There are more towns and cities in the union which will adopt, as Chicago and some other cities have already adopted, a general underground system, and compel all wires to go into this. Some are now in the agony of that sort of birth, some are not yet up to the scratch, but a good many will get there in the end. There will be a majority of these towns which will own and control the underground system they adopt, and I think they will do well. We hear every day from somebody, away off down in some swamp or back alley, shouting at the top of his voice, "underground is a failure." It is too late in the day to discuss that question. It is working in Chicago, and in our conduits we have as many varieties of wires as there are above ground in any two cities in the union—as many *kinds*, understand. We have everything from a cable less than an inch in diameter, with fifty wires in it, up to a cable as big as your thumb and only one wire in it; we have telegraph and fire alarm, and telephone and call bells, watch service, mercurial and burglar alarms, and police, and—well, if you can think of anything else, call the turn. We have it in our conduits, and they all work, and work far more satisfactorily than the overhead undertakers' lines. Don't let the croakers rule you off the track. I would say then, put them underground, if that can be accomplished, and pull down every wire which is overhead. Many of you can not accomplish that desirable end.

As a second choice, I would say put them under control of an electrician, if possible, who will, under proper authority from the heads of the government, kindly but earnestly enforce such changes in bad installations, and compel such methods in new ones, as will render the work reasonably safe. The parties who do this inferior sort of work are not wholly to blame, for what seems to be willful or careless. They do not know. Take an example which recently fell under my eye near Chicago. An outdoor installation was being constructed where a part of the wires were run on the joists underneath an uncovered platform. The wire was of the description above alluded to—underwriters'. The floor was dry, the joists ditto, and the wire was run without insulators. Before the work was fairly finished, a heavy shower came up, and the whole plant was so thoroughly wetted that it had to be done pretty much all over before it was fit to run. Now, if the constructor had been permitted to finish and get out of the way before that shower came, he would always have thought he had done an excellent piece of work. As it was, he said he had no idea of rain getting under the planks, although they were hardly close enough together to play marbles on.

If, in the third place, it is neither possible to control the the wires by burying nor inspec-

[1] Read before the National Convention of Chief Fire Engineers, at Atlanta, Ga., September 20, 1887.

tion, there remains but one course to be pursued, which is to have such restrictions thrown about the placing of plants as shall compel:

1. A class of wire to be used which is not affected by water.

2. Lines to be placed upon insulators everywhere in passing along buildings, and run clear of rods, awnings, etc.

3. If on poles, lines to be sufficiently high to prove no obstruction.

4. In crossing buildings, to be at least seven feet above the roof.

5. Lamps in front of a building, over the sidewalk, to be fixed and trimmed from a step ladder, or placed upon some form of crane which takes the strain from the suspension rope.

6. No joint to be made in the wire where it can reasonably well be avoided; all joints to be soldered and taped with insulating tape.

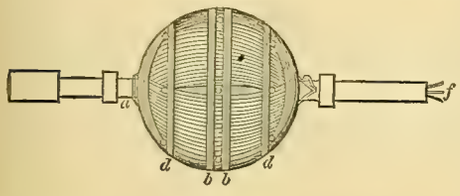


Fig. 29.

7. At all points where abrasion is possible, or where wires pass through partitions or into buildings, particular care to be taken to preserve the insulation intact. And even then there should be some method of testing the lines for insulation, though that is in the line of an inspector's duty, and some instruction is necessary to accomplish this.

In the matter of incandescent or glow lamps, there is less of danger to person, but there are forms of this system which are attached to and made part of arc circuits which actually make this worse than a simple arc line, because the majority of such combinations are liable to do some unexpected thing, and it is always the unexpected which happens. An incandescent circuit, pure and simple, owes its safety largely to the introduction of fusible strips at the various branchings of the wire, and there should never, where possible to avoid it, be more than six of these lights to one of these safety devices.

We are constantly reminded by the curious and apparently lawless action of electrical force that it is the possibilities and not the probabilities of the case which we must guard against and prevent. No two consecutive cases are precisely alike, and no law can possibly stipulate all the points to be watched in every possible case. Some judgment, some discretion must be left to the inspector, the examiner, or expert, and he should be able to explain clearly and fully why he demands this or that in one case which he has

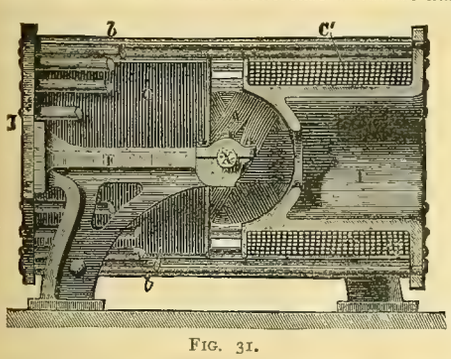


Fig. 31.

not required in another; and when he has made the demand, or given the order, there should be no lack of authority at his back, and no interference with him, on account of friendship or favoritsm. If the man is capable, stand by him; if he is not, let him go, and find one who is. I have briefly outlined a few thoughts on this subject which will bear elaboration far beyond the time you would place at my disposal. I shall be happy to give any who may desire it any information which practice and experience may have placed at my disposal, and trust that I may possibly have dropped a hint or two to aid in the good work of protection from danger, while encouraging the proper advance of electricity as an illuminant and power.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

NUMBER XI.

The Thomson-Houston Dynamo.—This dynamo has a very peculiar construction. Its armature shown in Fig. 29, is nearly spherical. Its core shown in Fig. 30, consists of two cast-iron flanges, G G, the one on the left shown in perspective, and the one on the right in section. These are attached to the shaft, and connected by twelve cast-iron ribs, D D, as shown, supported by the flanges but insulated from them. These ribs are over-wound with several layers of annealed iron wire, coated with shellac, filling the exterior space between the flanges, as shown at I I. At the ends and center of each rib are inserted projecting wooden plugs, shown at P P P′, 36 in all, designed to sustain the coils in position. The core thus constructed is covered with several thicknesses of paper for insulation. The three coils, composed of insulated copper wire, are joined in one closed circuit by connection with a copper ring at *a*, Fig. 29; and each of the three coils, starting from this point at distances apart of 120 degrees, are wound between the wooden plugs over the core in the direction of its axis, as shown in Fig. 30, in the following order:—1. First half of first coil. 2. First half of second coil. 3. Whole of third coil. 4. Second half second coil. 5. Second half of first coil In this way each coil is placed at the same average distance from the core. When the winding is completed the free ends of the three coils, shown at *f*, are led through an opening in the shaft and attached to the three segments of the commutator, and the armature is bound together in the usual manner by bands of brass wire shown at *b b*, *d d*.

The field-magnets, shown in Fig. 31, are con-

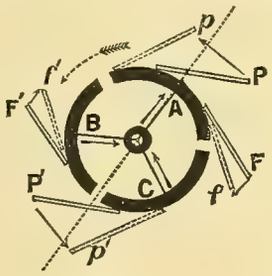


Fig. 32.

structed with two tubular, cast-iron cores, open at the outer extremities, and terminating in broad flanges, while the inner extremities terminate in spherically concave pole-pieces, which nearly inclose the armature, and are furnished with brass flanges, between which and the outer flanges the magnet coils are wound as shown at C and C.′ These two cores are bolted together by bars of soft, wrought-iron, *b b*, connecting the outer flanges, forming virtually, when wound, one magnet, its poles facing each other in the center where the armature revolves. The pole-pieces being inclosed within the magnet coils, and the armature brought into immediate contiguity with them, there is an increase of magnetic intensity upon the armature, which is inversely proportional to this reduction of distance, and consequently much greater than if the pole-pieces projected in the usual manner. The pole-pieces being spherically concave, concentrate the magnetism of the field upon the spherical armature by radiation towards its center. In the latest machines the mass of iron in the magnet cores is increased by the addition of iron ribs, not shown in the cut, radiating from the interior rim of each pole-piece to the tubular portion of the core. The magnets of the arc-light machines are series-wound with number 12 insulated copper wire; those of the incandescent-light machines are compound-wound, the fine wire of the shunt covering the tubular part of each core, while the coarse wire is wound in a peculiar manner close to the pole-pieces, and separated from the fine wire by the projecting flanges, hence both circuits excite the field-magnets, and, being joined at the brushes, their currents traverse the armature coils.

There are two pairs of brushes which bear on the commutator in the manner shown in Fig. 32: these, as shown in the perspective view of the dynamo, Fig. 33, are attached to a yoke and controlled by a magneto-electric regulator placed in the circuit, and mounted on the supporting frame of the dynamo, as shown at the left. By the operation of this regulator the brushes of each pair are drawn together or separated, as shown in Fig. 32, and the current intensity increased or diminished as required. The rotatation being in the direction of the external arrows, the position of best action is represented by the line *m m′*, and the direction of the current by the internal arrows; consequently when the brushes occupy positions near this line, as at P F and P′ F′, the current intensity is greater than when they recede from it to the positions *p f* and *p′ f′*. In the first position the brushes of each pair being 60 degrees apart, and the length of each commutator segment being a little less than 120 degrees, the two brushes of one pair always bear on one segment, while each brush of the opposite

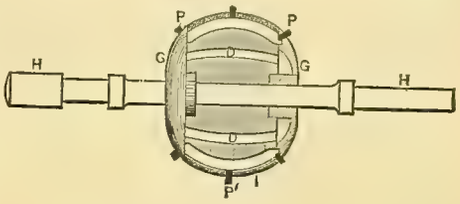


Fig 30.

pair bears on a seperate segment; so that two coils are always in parallel and are in series with the third coil, as shown. The current intensity, under these conditions, must always be greater than when the brushes occupy the second position, the brushes being nearer the line of maximum intensity, and the time of contact with each segment in this best position being thus prolonged. But when they recede to the second position they are farther removed from the line of maximum intensity, the time of best action is reduced, and, six times in each rotation, two opposite brushes momentarily touch the same segment and are thus short-circuited. Hence, under these conditions, the current intensity is reduced in proportion to the distance apart to which each pair of brushes is separated. When from a reduction of resistance in the lamp circuit by the extinguishing of a lamp or otherwise the intensity of the current feeding the remaining lamps becomes liable to an abnormal increase, this increase is shunted through a very sensitive electro-magnet, termed the controller-magnet, connected with the regulator-magnet of the dynamo, already referred to; the armature of the regulator is attracted, the lever connecting with the brushes is raised, the brushes separated, and the current intensity reduced. When, from an increase of resistance in the lamp circuit greater current intensity is required, this operation is reversed; the brushes drawn closer together, and the intensity increased; the brushes being so adjusted that one commutator segment is out of connection during each revolution. This system

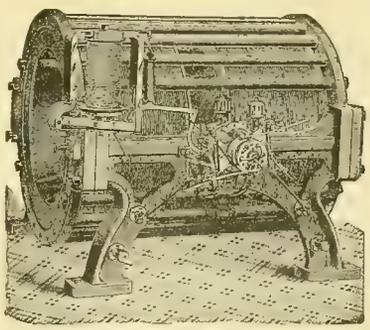


Fig. 33.

of automatic regulation, variously modified, is practically the same as that in use in other dynamos already described.

One striking peculiarity of this dynamo is the air-blast spark-controller; a mechanical contrivance by which air is blown against the brushes at their points of contact with the commutator, by which means sparking at these points is suppressed. The box in which the blast is generated is shown in Fig. 33, just back of the commutator, and one of the jets just above it.

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With this number of the WESTERN ELECTRICIAN we complete the first quarter year of the paper's existence, and we offer it as a striking example of newspaper enterprise and success.

Three months ago this journal was but an idea; to-day its thirteenth weekly number appears and bears on its pages indications of its solid, substantial basis.

A corroboration of the judgment and faith of the paper's projectors and conductors as to the need for such a journal in the magnificent field offered by the west is found in the current number, and yet the well-nigh instant success of the paper is remarkable.

During the thirteen weeks of the paper's existence it has not issued less than a total of twenty-four pages in any number, and it has issued as high as thirty-eight pages in one number. This record has never been excelled by any weekly electrical paper, young or old, save in a single instance, and when it is borne in mind that this record has been made by a paper in the first quarter year of its existence it may be considered well-nigh phenomenal. Conclusive proof of the character of the WESTERN ELECTRICIAN and of the esteem in which it is held by its patrons, advertisers and subscribers, is shown in this number and the record of the first thirteen weeks.

In our salutatory we promised to publish a first-class electrical paper. We have given an earnest of our intentions in the numbers already issued. Though besieged by the difficulties that beset every new enterprise, we have not been discouraged, but have redoubled our efforts to produce a paper that would be able, newsy, bright, attractive and handsome. Our rapidly growing subscription list is evidence that the WESTERN ELECTRICIAN is appreciated, but we hope, ere another quarter has rolled around, to have added new features, to have enlarged our scope, and to have presented even more meritorious numbers than we have already placed in the hands of our subscribers.

THE evidence and proceedings of the courts in matters of litigation are at best prosy reading, but the narrative published in this issue of the test of the Cushman "talking boxes," near Chicago, a week ago, brings out some extraordinary features of an unusual experiment, which is sufficiently attractive to call for attention.

A BRIEF note appeared last week of an installation of the storage battery in a street car to supply an incandescent light system. The application is novel and interesting, and the results will be watched with interest.

SIX young German scientists recently fell victims to their zeal in scientific exploration, in attempting the ascent of the Jungfrau without guides; one object of the expedition being to study the subject of lightning discharges, as shown in their traces upon the cliffs. Their second night on the mountain was spent on the highest peak, in a storm, against which they had erected a temporary shelter, where various relics were subsequently found. Descending on the opposite side, in a fog, in the early morning, tied together by a rope, they fell from the edge of a cliff 600 feet high, and three days later their bodies were found in the snow below.

THE article by Elmer A. Sperry on "protection of dynamos from lightning," which we print elsewhere, is on a subject of great practical importance, and will be read with interest. The article takes rather a wide range, discussing the relative importance of protection for telegraph and telephone lines. The views on the electric conditions of the earth and atmosphere during thunder storms, are sound. The reference to "potential jumping" in the lightning arrester, strikes us as a little odd. It is easy to see how an electric charge can pass from one limb to the other, and the potential thus become equalized, or changed, and probably this was what was intended.

THE advantages of the telephone were strikingly exemplified in the announcement of the recent decision of the Illinois supreme court, in the celebrated anarchist case, Sept. 15th. The various correspondents of the press stood in breathless expectation awaiting the announcement, and when, on the opening of the court, at 9:20 a. m., the dread decision was given, confirming the decree of the lower court, and consigning the seven murderous conspirators to the gallows, and one to the penitentiary, there was a grand rush down the street for the telegraph office, every available means of rapid transit being brought into requisition. What was the chagrin of the runners, to find, on arrival, that the news had already gone over the wires, a correspondent of a rival sheet having saved his muscle, and quietly used the telephone.

THE experiments of Dr Tommasi, on multiple telephony, given in this issue, opens a new and comparatively untried field, in which a rich harvest awaits the successful inventor. Multiple telegraphy and telephony are both still in the experimental stage, that of telephony being in its earliest infancy, while that of telegraphy has little more than passed the quadruplex stage, the multiple telegraph, with revolving disk and synchronous movement, though known and used experimentally for several years past, having never been sufficiently developed to come into general practical use. It does not follow, however, that the telephone must wait for it, though the difficulties in the way of accomplishment in the latter case would seem to be greater than those attending multiple telegraphy, according to the method proposed by Dr. Tommasi; yet some other thinking brain may find a shorter and easier route to the desired goal, where honor and profit await the victor.

There is a constant public clamor for the practical as opposed to the theoretical; for actual cash-producing inventions as opposed to those still in embryo; for the accomplished results of the factory as opposed to the preparatory work of the laboratory. Foundation work is regarded with disfavor, and finished structures are demanded. Elisha Gray, the dreaming scientist, experimenting with tin pans and wires, is of small account in public estimation, but Elisha Gray, the inventor of the telephone, is world-renowned. Goodyear, with his crucibles and his laboratory, spending his last dime on chemicals, while his starving family subsist on charity, is regarded as a lunatic; but Goodyear's hard-rubber is to-day an indispensable requisite in electric work, without which the great achievements of many of the great electric inventions would have been impossible. But the world forgets all this, and the poor inventor still treads his thorny path alone, neglected, despised perhaps, till from the seclusion of his laboratory he comes forth with some brilliant achievement, and becomes the world-renowned hero.

The National Telephone association will meet in convention Monday, the 26th inst., at 11 A. M., at the Monongahela house, Pittsburg, Pa. The convention promises to be very interesting and the attendance as large as usual.

Quarters for the WESTERN ELECTRICIAN representatives have been secured, and members of the association are cordially invited to avail themselves of their conveniences.

ANY person reading the description of the very remarkable tests of the pulsion mechanical telephone, given in another column, must be impressed with the fact that the wonderful facility of transmission and reception shown by the tests militates against the usefulness of the apparatus.

If the message can be heard distinctly, at a distance of sixty feet, in the open air, by laying a hat against any part of the line, then all privacy of transmission is at an end, and bucket shops, rogues, and detectives can pervert the apparatus to carry out their own designs. The apparatus is altogether too good, and verifies the original objection made against the electric telephone before its character was understood. The very fact that the electric telephone requires for its use a delicate, scientific receiving instrument, through which the message is audible only to the recipient, is one of its chief excellencies, and puts the seal of privacy upon it, which can not be violated with impunity.

If we are to believe an Austrian paper, the first lightning-rod was not constructed by Franklin, but by a monk of Seuftenberg, in Bohemia, named Prohop Diwisch, who installed an apparatus the 15th of June, 1754, in the garden of the curate of Prenditz (Moravia). The apparatus was composed of a pole surmounted by an iron rod supporting twelve curved-up branches, and terminating in as many metallic boxes, filled with iron ore and closed by a boxwood cover, traversed by twenty-seven sharp iron points, which plunged at their base in the ore. All the system was united to the earth by a large chain. The enemies of Diwisch, jealous of his success at the court of Vienna, excited the peasants of the locality against him, and under the pretext that his lightning-rod was the cause of the great drought, they made him take down the lightning-rod which he had utilized for six years. What is most curious is the form of this first lightning-rod, which was of multiple points like the one which M. Melseu afterward invented.

The most sensitive instrument yet made for measuring degrees of heat has recently been exhibited at a soiree of the Royal society by C. V. Boys, who calls it the radio-micrometer, says *Leisure Hour*. As may be imagined, it is an improvement upon the thermo-electric pile, an instrument which, measuring radiant heat by the electric resistance of metals when their temperature is raised, first came into popular notice by being employed to measure the radiant heat of the moon. By employing the thermo-electric pile in connection with a galvanometer, Melloni was able to measure radiant heat to the 1–5000 of an inch. But the radio-micrometer is about one hundred times more sensitive than the thermo-electric pile. The most minute increments of radiant heat are instantly detected by it. Mr. Boys is able to produce a visible effect of heat on a halfpenny held at a distance of more than 1,100 feet flom an ordinary candle flame. Prof. Langley's "bolometer" had already surpassed the thermo-pile and galvanometer as a delicate means of detecting heat radiation, but the radio micrometer, says the inventor, has about one hundred times the sensitiveness of the bolometer. The one hundred millionth of a degree of heat is within the range of its powers of detection. The electric apparatus consists of a movable circuit of copper, antimony, and bismuth, hung by a quartz fiber in a strong magnetic field.

The Theory of Telephone Conductors.

BY DR. V. WIETLISBACH IN ELEKTROTECHNISCHE RUNDSCHAU.

PART III.

The self-induction of the apparatus switched into the line is, under ordinary conditions about

$$-1.10^9 \text{ cm} = 1 \text{ W}.$$

For copper wire we have:

$$q = 37.4\,;\quad a = 66\sqrt{\frac{1}{n}}$$

and for iron wire

$$q = 35.6\,;\quad a = 660\sqrt{\frac{1}{n}}$$

The relative intensities of partial tones for different numbers of oscillations give us the following values for a=1:

No. of Oscillations.	100.	500.	1,000	10,000.
Copper	.0043	.0044	.0044	.0044
Iron	.0022	.0036	.0032	.0043

While in the case of copper wire the intensity varies hardly 2 per cent. for tones having 100 to 1,000 oscillations a second, it increases 50 per cent. in the case of iron wire. By increasing the self-induction p of the apparatus, the influence of the number of oscillations may be reduced, but the effectiveness of the sound will be weakened in like measure.

It is to be recommended, therefore, that for long lines copper wire be employed, as this obviates the influence of the number of oscillations. Actual experience agrees with the above result. According to *Verkehrszeitung*[7] intelligible speech over the iron Berlin-Hanover line 340 kms. in length is difficult, and possible only from especially equipped stations. On the other hand, good transmission was achieved over a copper wire between New York and Chicago, a distance of 1,500 kms., by Rysselberghe and others, with ordinary apparatus.

To avoid the mutual induction of single parallel wires, air lines are often constructed in metallic circuits, so that the separate lines consist of two immediately adjacent wires, through which the current passes intermittently in opposite directions. It is easy to establish absolute formulas for this arrangement as well. To the self-induction of the line, which is doubled on account of the double length of the wire, there is added the mutual induction of both halves of the metallic circuit. As the current goes in opposite directions in these halves, self-induction and mutual induction antagonize each other. If d denotes the distance between both metallic circuit wires, then the mutual induction is

$$Q = l\left[4 \ln \frac{d}{r} + \mu\right]$$

and the entire induction of the wire is represented as follows:

$$P = p + l\left[4 \ln \frac{2l}{r} - 3 + 2\sqrt{\frac{\mu\rho}{4\mu n}} - 4 \ln \frac{d}{r} - \mu\right]$$

$$= p + l\left(4 \ln \frac{2l}{d} - 3 - \pi\left[1 - \sqrt{\frac{\rho}{4\pi n \mu}}\right]\right)$$

and the strength of the current:

$$\text{V.}\quad i = \frac{A}{P\sqrt{1 + \frac{l^2 \mu \rho}{\pi n P^2}}} \cos(2\pi nt + \delta).$$

The relative intensities for different numbers of oscillations are represented for a line of 300 kms. in length under the above conditions, by the following table:

No. of Oscillations.	100	500	1,000	10,000
Copper ...	.00381	.00407	.00415	.00430
Iron.....	.0024	.0053	.0071	.0030

7 Jan., '87, p. 37; also *Archives f. Post u. Telegraph.*

A metallic circuit of iron wire is thus much worse than a single circuit. According to the reports of Preece mentioned above intelligible speech over the iron metallic circuit London—Liverpool was possible only through a distance of 160 kms. while over the copper metallic circuit Paris—Brussels (200 kms.) New York—Boston (600 kms.) intelligible speech is comparatively very easy.

Generally every line has capacity as well as self-induction and the results obtained above are influenced by them. In this case too, we can by calculation make approximate estimates. If the influence of capacity is predominant, we can use formula I into which we must introduce for resistance the numerator of formula III. If, conversely, self-induction is predominant we make use of formula III and introduce for self-induction the value

$$P - \frac{1}{(2\pi n C)^2}$$

Such calculations must be made with the greatest care because in them two factors, self-induction and capacity, are compared with each other, and their action is fundamentally different. Self-induction propagates itself with the rapidity of light over the entire line, and the current variations which it causes, make themselves perceptible at the same moment at all points of the line, and the strength of the current is for this reason the same, at the same moment, over the entire line. Capacity on the other hand acts only at those points of the line at which the necessary conditions are found.

The current variations caused by it do not propagate themselves over the line, but remain limited to a particular point. For this reason the strength of the current will not have the same value at all points of the line, but can have very different values at the same moment, according to the distribution of the capacity over different parts of the wire.

Since capacity strengthens deep tones and self-induction weakens them, a line can be established by a combination of the two in which mutilation is largely obviated. Over such a line tone color will remain unchanged, and only a uniform weakening of all waves is manifest. An aerial line consisting of copper, seems to fulfil this condition almost entirely. This shows that it is reasonable to fix the distance over which transmission is possible by the product CW only for cables with large capacity. For other lines in which self-induction plays a part, this factor loses its importance entirely. The essential thing to know is, the change in the strength of the current, when the number of oscillations varies, that is, the value

$$\text{VI.}\qquad \Delta = \left(\frac{di}{dn}\right) : i.$$

This value cannot go beyond a certain limit of n which depends on the range of the speaking voice somewhere between n=100 and 1,000.

In my investigations of telephone cables, I conclude that this value must remain smaller than .02. When this limit becomes known, calculation will easily determine to what distance a line will permit good transmission. As the action of capacity and of self-induction compensate each other up to a certain point, for that reason the influence of capacity as well as of self-induction separately may be larger in a mixed circuit than in a simple circuit. If we determine values of capacity and of self-induction derived from the same source, and permitting good transmission, and construct a curve with them as coordinates, this curve will be nearly elliptical in form.

The experiments which have been made with so-called artificial cables in conversation over submarine cables, show that it is not sufficient to combine a certain resistance and a certain capacity to obtain a certain effect, but that the distribution of these electrical properties over the cable plays a very important part. Similarly the distribution of capacity, of self-induction and resistance will exert a very important influence in establishing the precise theory of telephone lines, and these influences are to be taken into consideration; but the simplest conditions always afford the most favorable circumstances for actual use.

The principal results of investigations hitherto can be comprehended in this, that the most complete circuit is a simple aerial copper wire; the worst a simple cable wire with large capacity or a metallic circuit of iron wire. For practical use a metallic circuit of copper combines the greatest advantages. Transmission through this is almost as perfect as through a simple copper wire and the cables which may be necessary can be introduced for a considerable distance. Thus there is a metallic circuit between New York and Philadelphia of 150 kms. of bare copper wire and 10 kms. of cable, and communication over this line is as easily carried on as between telephone stations in the cities themselves. Beside the possibility of introducing cables into the circuit, another important consideration advocates the introduction of metallic circuits, and this is the fact that induction disturbances from foreign electrical sources are almost entirely obviated. Of course, a metallic circuit of copper wire is the most costly line, and experience must show whether construction and maintenance costs are in accord with actual benefits derived from such plants, and this is the more so because only by the most excellent insulators and the most painstaking care can the insulation be kept at the height which telephony requires for long lines, and the maintenance of insulation is at present the most difficult problem in long distance telephony. The insulation of telegraph lines shows itself to be insufficient in damp weather for telephone purposes.

If in time a general need of long distance telephone lines should assert itself, then a system of this kind could be used only if the stations of the separate subscribers who are to be connected with each other be especially adapted to these circuits. To make use of metallic circuits with plants as established, the metallic circuits are at present occasionally connected with the simple subscriber's circuit by a transmitter or translator, but as transmission is always combined with mutilation and considerable weakening, this assistance must be thrown out when it is desired to overcome long distances.

In this case the connection of telephone stations with exchanges must be effected by two wires, and the apparatuses must be actuated to a resonance which is greater in proportion to the greater distance. Evidently such a reconstruction is unnecessary for subscribers who desire to converse only in the center of the city. The question comes up whether all subscribers' stations should be reconstructed as above, or only those to be used on the long lines. If a system is principally aerial, it will hardly be possible to bring two wires to every telephone, as roofs and poles would be too heavily loaded. Only the subscribers who especially desired it would be supplied with such a line. This is the present method in America, especially in New York and Philadelphia, and as far as the apparatus is concerned, is used by the German Postal department for the systems introduced into the circuit Berlin-Hanover.

In large stations, on the other hand, in which the preponderating part of the plant consists of cables, it is to be recommended that every station be in a metallic circuit. We gain two great advantages by this; in the first place the plant becomes a unit, especially at the central station, and then, as we have seen, transmission through the cables in metallic circuits is decidedly better than through simple cable wires. The cost of a plant for a simple wire, free from induction, and a metallic circuit is, moreover, about the same. There are, at present, such systems in Paris, Ostend, Newcastle on-Tyne and Brescia.

The value of switching in metallic circuits is not so apparent in these separate systems, as the chief advantage consists in the ease with which conversation is carried on over long distances.

It is probable that several years will pass before this system has come into general use and will be the rule in all large telephone plants; but a rational development of long distance telephony will be possible only on this basis, and experience must decide to what extent such establishments will satisfy an actual need which the telegraph does not satisfy.

(*Concluded.*)

Multiplex Telephony.

Dr. Tommasi, writing in the *Moniteur Industriel*, describes a method of utilizing a single wire for the simultaneous transmission of a considerable number of telephonic conversations between distant exchanges. The method is based upon the phenomenon of the persistence of the sensation of sound—analogous to the well known persistence of the sensation of light upon the retina. That an effect of this character does exist is evident from the fact that we hear musical tones of above 16—double—vibrations per minute as a continuous sound, and not as a succession of waves such as really exist in the atmosphere. Dr. Tommasi, therefore, proposes to make use of the principle employed in multiplex telegraphy and to cause rotating cylinders to make successive contacts between the several lines which are to be joined, each contact recurring in less than one thirty-second of a second. The cylinder must, therefore, rotate at a rate of about 2,000 revolutions per minute. It is further necessary that at the opposite end of the single line wire a similar cylinder be maintained in absolutely synchronous rotation, so that the two cylinders shall always connect the same lines at the same moment. Dr. Tommasi suggests that the first cylinder should be driven by a small electro-motor, and that the synchronism of the second should be maintained "by one of the well-known methods." It is doubtful whether there is any known method by which this can be done other than Delany's adaption of LaTour's "phonic wheel." In this case, as Dr. Tommassi points out, it will be necessary to run a separate circuit for the performance of this regulation. It must be admitted that the method does not appear very promising, because the make and break of the circuit at the rate of thirty-two times a second will itself give rise to such a noise that we can hardly expect that conversation can be conducted with any degree of comfort, even if it is possible at all. This difficulty seems to us a very grave one; if, however, it can be overcome we should be inclined to anticipate an important future for Dr. Tommasi's device. Only last week we mentioned that there are now twenty-five telephonic circuits in use between New York and Philadelphia, and it is obvious that any method which promises to do the same work with only two circuits is decidedly worth consideration. In the North of England, again, there are several trunk lines upon which—although neither so long nor so heavily wired as the Philadelphia route—the profits are yet nearly all swallowed up in the cost of maintenance. So that here again a reduction in the wire mileage would probably afford perceptible relief. We may add that Dr. Tommasi hopes to find that in practice it may be possible to work at a lower number of revolutions of the cylinder, because it may turn out that the diaphragm of the receiver has, by reason of its elasticity, a tendency to perform a larger number of vibrations than that due to the actual impulses of the magnet.—*London Electrician.*

Transmission of Energy.

It has recently been shown by a writer in the French journal *La Genié Civil*, that the efficiency of transmission by compressed air cannot exceed 45 per cent. for distances of about a quarter of a mile, while beyond this it is still less, and that the system is necessarily dearer than transmission by water pressure, except for distances exceeding about three miles. The calculation is based upon a total transmission of 100 horse-power. Now (quoting from the same writer) let us compare each of these methods with the cost of transmission by electricity and with wire ropes. The result is shown in the following table, where the original source of power is (1) steam, (2) turbines:

System employed	330 Feet.	1,640 Feet.	3,280 Feet.	16,400 Feet.	32,810 Feet.	65,620 Feet.	Motor.
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	
Electricity	1.80	1.84	1.91	2.27	2.84	4.61	Steam.
Water pressure	2.27	2.[illegible]	2.61	4.03	5.79	9.57	
Compressed air	4.17	3.23	3.33	4.05	5.25	6.39	
Ropes	1.20	1.10	1.58	2.88	4.99	12.68	
Electricity	0.41	0.48	0.53	0.62	0.68	1.15	Hydraulic.
Water pressure	0.47	0.55	0.62	1.33	2.23	3.54	
Compressed air	0.77	0.80	0.84	1.21	1.86	3.36	
Ropes	0.[illegible]6	0.27	0.30	0.80	1.42	3.39	

It will be seen that for 100 horse-power compressed air is absolutely the most expensive method in all cases. For distances less than 16,400 feet wire ropes are at first cheaper, while beyond such distance electricity comes rapidly and unmistakably to the front. But immediately we contemplate not merely the transmission but also the distribution of energy, ropes are altogether out of the question, and can not for a moment compete with electricity for convenience and ease of handling. Relative calculations of this general nature do not, of course, pretend to anything more than an approximate degree of accuracy; but it may be stated that similar calculations by independent authorities have invariably given results of the same general character. (See, for instance, the valuable tables in Kapp's "Electrical Transmission of Energy.")—*London Electrician.*

Shocks from Alternate and Direct Currents.

To the Editor of WESTERN ELECTRICIAN:

In your issue of September 10th, I find reproduced an article read before the Chicago Electric club by Mr. C. C. Haskins, in which he criticises some statements made by me at the meeting of the Electric Light association in Boston. He remarks that there did not seem to be any very lively discussion, "but rather tacit submission to the statement." I do not know whether Mr. Haskins was present at Boston or not, but I can assure him that I had to answer questions enough after the meeting, and none of the men who were actually handling electric light currents seemed to think any part wanting in the story, and had Mr. Haskins asked myself direct without rushing into print, he might have found that there was no "other wire" to produce or modify the effect described.

Perhaps Mr. Haskins is not aware that in the induction system, of which I was speaking, we run an alternate current of 1,000 volts constant potential, and that all of our converters are connected in multiple arc across the two main wires, and that as one of these wires was grounded and the man stood on the wet ground and took hold of the other wire, he would get through his body 1,000 volts or less, according to the condition of the ground and the nature of his contact with it. If he does not believe this, I shall be very happy to permit him to try it on our circuits any time that he wishes.

He says that he finds the "matter of induced, of secondary, of alternate currents," is very little understood. I fully agree with him. If he will read the proceedings carefully, he will find that I gave as a possible reason for the shock from the alternate current on our system not being so severe as that from the direct of the same potential, the fact that we had very little wire on the armature to create the self-induced extra current, and the field magnets being separately excited there was no field discharge into the line.

One point which Mr. Haskins makes with regard to the grounding of the secondary wire for the purpose of avoiding shock is well taken. I said nothing about this at the meeting, not thinking it worth while, as I am sure that no man practically in charge of an electric lighting station will ever resort to so utterly foolish and dangerous an expedient to cover up what is after all simply bad workmanship—faulty insulation—whether in line, or dynamo, or converter.

As Mr. Haskins wishes to know "full particulars" as to the shocks that I have received, and of which I spoke at Boston, I will give them to him, and he can repeat the experiments whenever he likes and compare results.

Let him take a 30 light Brush machine, running with a full load of lamps, take hold of the bare wire in one hand and a brass coupling in the other, and pull them apart. (I did this, of course not knowing that the current was on the wire.) Result: A couple of burns on the hands, a knock down off a step-ladder, and blue spots and general stiffness and soreness in both arms and across the chest for a week afterward.

Secondly, let him stand with wet feet on the wire running from the negative terminal of a Thomson-Houston 20-light machine, and hold on to the positive terminal while somebody else—with the idea of releasing him—opens the line. Result: Burnt hands and blistered feet.

Thirdly, let him come into one of our alternate current stations where the bars of the switch-board are of bare copper about one foot apart, with a difference of potential between them of 1,000 volts, and let him, while coupling in a new circuit, place one hand on each bar. Result: Two little burns, about the size of pin heads, on each hand.

After these experiments he will be in a position to criticise.

Mr. Haskins showed in one of his experiments that he got a spark and a shock from the extra current from a magnet with six LeClanchè cells. If he will call at our station in Pittsburgh, I should be happy to show him the breaking of an alternate current of 65 ampères at 1,000 volts (the full current of one of our 1,300 light dynamos), with no more spark than would be seen in the breaking of a direct current of 2 ampères at 100 volts, and in about three weeks I expect to be able to show him 130 ampères at 1,000 volts (or 2,500 lights) broken with no greater spark.

Mr. Haskins does not seem to have at all understood the purport of my remarks, which was not that the 1,000 volt alternate current is harmless, but that the 1,000 volt alternate current is very much less dangerous than the 1,000 volt direct current, and I would call his attention to the fact his spark and shock from the six cells of battery and magnet is a direct current, and not an alternate current, and not an alternate current, and may easily be of many hundred volts.

If we live on natural gas in Pittsburgh, a good deal of my experience was gotten in conservative Philadelphia. While not a Pittsburgher, I am proud to think that Pittsburgh has produced a few things in the electric light line which would make Mr. Haskins open his eyes if he would examine into them.

I am sorry to take up so much of your valuable space, but my remarks were made in the hope that they might be of benefit to those who, like myself, are placed in charge of electric light plants, and I do not wish to let any light and airy criticism interfere with any possible good that I can do for my fellow laborers. I give entirely the practical side of the question, and leave the scientific explanation to those who have made a special study of the subject. I know the results, and spoke of what I know, and nothing more.

T. CARPENTER SMITH.

Pittsburgh, Pa., Sept. 13 1887.

CORRESPONDENCE.

Eastern Electrical Comment.

NEW YORK, Sept. 17.—The legislative investigation into the telephonic affairs of the state, began this week at Troy. Its object is to ascertain whether the profits are sufficient to warrant a reduction of telephone rentals to three or four dollars per month, as was proposed by a bill introduced in the legislature last session. The affairs of the Commercial Telephone company doing business at Albany and Troy were first examined, and the officers, according to reports, represented a very satisfactory condition of the finances. With a capital of $50,000, and a plant costing $100,000, the company managed to pay a dividend of 44 per cent. last year. The committee went from Troy to Rochester.

It is hardly to be expected that any statement regarding negotiations for the purchase of the Baltimore and Ohio lines by the Western Union Telegraph company can be accepted as a fact President Bates has been reported as saying that a syndicate stood ready to take hold of all the competing lines, and thus prevent their absorption by the Western Union company. This appears very probable, provided a sufficient cash payment could be made to satisfy the present owners of the Baltimore and Ohio property. Judging from the sale of the express business, the matter of sentiment will not stand in the way of getting the largest possible price for the lines from whomsoever can produce the requisite amount of money.

The curiosity which was expressed as to the reasons for the resignation of Major John Powell from the management of the Brush-Swan company, of New England, has been partially satisfied by his bringing suit against that corporation and the parent company at Cleveland for $1,000,000. Other gentlemen are associated with him in the suit, which is based on the claim that Powell and others have paid a considerable amount of money for certain rights and privileges in the use of appliances supposed to be controlled by the Brush company. Their money is invested without any prospect of returns, and suit is brought for recovery of the same.

The suit of William McMahon against Maurice B. Flynn, to obtain $250,000 stock in the Subway company, is likely to be settled by a compromise. Mr. McMahon was a "promoter" in the scheme in which he engaged to enlist certain capitalists, and claimed to have been promised the amount of stock for which he sued. At the last hearing an adjournment was taken until October 15th, but if the negotiations now on foot succeed, the case will doubtless be discontinued at that time.

There is a brisk electrical conflict at Elizabeth, N. J., in both the lighting and railway fields. The Schuyler company has been giving a very satisfactory arc lighting service for nearly two years, but since last February, the smaller city of Plainfield, which is in some respects a rival town, has been indulging in the luxury of incandescent lights supplied from the Westinghouse system. Henry W. Pope, formerly president of the Elizabeth Schuyler company, has endeavored to arrange for the introduction of the Westinghouse in combination with the Schuyler arc system. Being unsuccessful, however, he has organized a new Westinghouse company, applied to the council for a franchise, resigned the presidency of the old company, and started the conflict Melville Egglestone was elected his successor in the Schuyler company, and is vigorously opposing the new-comer on the ground that the existing

company intends to introduce the very best incandescent system which can be obtained, and there is not room for two companies to earn a living. Both parties have appeared before the council committee and each offers similar inducements in the way of free lighting, provided the council will decide in its favor. The prospect appears to have been sufficiently realistic to the gas company to cause a reduction in the price of gas from $2.50 to $1.75 per 1,000 feet after the 1st of October.

The street railway question came up before the council Wednesday night. The opponents of the electric railway were on hand to denounce it as a failure, while Mr. Mailloux has been brought over from New York to prove that by the storage battery system success was assured. There have been a sufficient number of failures, and also of successful lines, to furnish the necessary argument for either side of the question. The subject is one of great interest, and it is to be brought up again next week by the American Institute of Electrical Engineers, at their first dinner and meeting of the season, September 20th. Anthony Reckenzaun, of England will read a paper on "electric street cars, with special reference to methods of gearing." At a former meeting the subject was successfully handled, there being present Messrs. Julien, VanDepoele and Field, together with Mr. Mansfield representing at that time the Daft company. Mr. Reckenzaun is thoroughly versed in the subject he has chosen, and the meeting will no doubt be of unusual interest.

The Erie railway recently introduced a block system on its main line through New Jersey. As is too frequently the case, the signals are said to have been placed in many instances in the hands of men who were already overloaded with numerous duties, and the consequence was that trains were blocked so effectually that few of them arrived at Jersey City on time. So much trouble was caused that the system, or more properly lack of system was abandoned, temporarily at least, until some plan can be devised of operating it more satisfactorily.

The growth of business has had a good effect on Western Union finances, and the resumption of dividends is announced for October 15th. As the company is now expending considerable money for reconstruction, its condition appears to be quite satisfactory. Edwin Gould has been elected a director in place of George D. Morgan, and Sidney Shepherd in place of Henry B. Hyde. P.

New York Notes.

New York, Sept. 17.—Since the news was first received of the Chinese concession, the papers here have been looking up the records of the men who are interested in it. They claim that the Count Mitkiewicz is a man well known to the New York police, and has an unsavory reputation. Philadelphia papers impute envy as the cause of all the unpleasant stories that are alleged by New York papers to be true about the count, and so he is a much discussed man at present. A Philadelphia correspondent sends some interesting facts about Wharton Barker, the leading member of the syndicate. He is of Quaker descent, and first came into prominence as representing the Russian government in managing the building at Cramp's ship yard of some Russian ships, Barker being the Philadelphia agent of Russia's bankers. He soon after formed a plan for developing the mineral resources of Russia, and organized an American syndicate for that purpose. A committee headed by Wayne MacVeagh visited Russia, submitted their plans, demanded all sorts of grants and monopolies from the government and never received any reply. So the syndicate came to an end, and Barker was talked about to his heart's content. At the time of the Chicago convention that nominated Garfield, Barker claimed that it was his influence that brought about the nomination, and made his demands on Garfield accordingly. Coming down to the time of the concession, it is said that the plan had long ago been worked out by Count Mitkiewicz and another man who had both been for some time connected with the Chinese embassy in Washington, and who were trying to find means to restore their shattered purses and reputations. Barker was just the man for them, and with his head as usual in the clouds, he looked right over their past, and sent them off to China to go through the form of a contract, which had really been in their keeping for months, and was hawked about among various promoters at home and abroad until it was taken by Barker. This is the story as told, and is given for what it is worth.

Philadelphia has been celebrating another centennial this week, and the city has been thronged with visitors. On Thursday there was an imposing historical parade, illustrating the advancement of the industrial arts and sciences during the past century. A fine display could have been made of the progress shown in the electrical field during that period, but according to reports, advantage does not seem to have been taken of the opportunity, for the electrical display was quite meager.

At the meeting of the Electric club on Thursday evening, the topic was "induction telegraphy to and from bodies in motion," on which a paper was read by Charles A. Cheever, of this city.

The exhibition of the American institute this fall, promises to be one of the most interesting and successful in the history of the society. For the electrical exhibition over 18,000 square feet of floor space has been allotted. More than twenty-five of the leading electrical companies, representing all branches of electrical industry, will have exhibits, and in addition there will be a loan exhibition of relics and historical apparatus.

E. M. Barton, president of the Western Electric company, has been in town this week. S.

From the Pacific Slope.

San Francisco Sept. 12.—A franchise has been granted by the Napa council to a company to run an electric railway in that city. Work is being pushed on this road along Main street and to the insane asylum.

Napa was lighted on the 9th by the Heisler incandescent system.

The electric railway company of Oakland has completed the construction of a road-bed and plant on New Broadway. The station is equipped with one 30 horse power dynamo, and each of the cars has an eight horse power motor. One mile of track has been laid. It is proposed to extend the line southward to Fourteenth street. So far everything works satisfactorily. Keith motors are used.

The steamer City of Pekin, running to Yokahama and China, is having an Edison plant, with an Armington & Sims engine, put in by the Electric Development company.

The steamer Umatilla is being overhauled. The California Electric works have contracted to put in an Edison plant and annunciators. The steamer runs from San Francisco to Seattle and Victoria, B. C. An Ide engine to be used.

Palmers & Rays, printers and machinists are having an Edison plant put in.

The Seattle Gas & Electric Light company at Seattle, W. T., are enlarging their electric light station and have ordered more American dynamos and another Ball engine.

Mr. Waterhouse, of the Waterhouse system, has made his appearance on this coast, after an absence of eight years. He was formerly a Californian.

During a thunder storm on the 11th inst., at Spokane Falls, five persons were severely shocked by the house in which they were sheltered being struck by lightning.

The city council of San Jose have granted J. B. Randall and others a franchise for an electric road. A road will be built along Market street to Basset, thence to First and along First street to the northern city limits. The contractors have filed a bond of $10,000 for the faithful performance of the contract.

The horse racing at Grass Valley by night, by the aid of forty arc lights, on a half-mile track, proved satisfactory to the spectators, who came from Nevada, Placer and Sierra counties.

A new Canadian steamer is being built by the Union Iron works. It is to have electric calls, and will be lighted by an Edison plant.

The Sperry flouring mills at Stockton are being wired for incandescent and arc lights.

George R. Longdon, constructing engineer and electrician for the Indianapolis Jenney Co., on the Pacific Coast, will leave on the 18th for Southern California to reside permanently. His company has large interests in that section of the state to be looked after. Mr. Longdon will go as far as San Diego, to examine that station and thence to San Bernardino and Riverside.

Long distance incandescent systems are in demand on this coast. Gas is selling at $5 a 1,000 feet in some sections of this coast, while water power can be got comparatively for a song. S.

Cincinnati Chat.

Cincinnati, Sept. 17, 1887. — A. G. Smith has displayed from the block opposite the government building a new departure in the way of advertising. It consists of a magic lantern connected with the electric lighting station, in which he uses a very strong electric light to throw the pictures and advertisements on a canvas twenty-four feet square. The views he gives from all over this and foreign countries are interesting enough to hold a crowd of spectators every evening. Among the many who have taken advantage of this advertising scheme are the different electric light companies of this city.

The fact that the city council are trying to compel the telegraph and telephone companies to put their wire underground has not discouraged the latter company in the least, as can be seen all over the city by the neat appearance of their poles, since receiving a good coat of paint. The matter will probably develop a strong fight this winter, as the city solicitor has decided it will have to go before the legislature and become a law before it can be accomplished.

It is now a fixed fact that John Kilgour, president of the Consolidated street railway has been seeking more roads to conquer. He has control of the White Line street railway at Dayton, O., and has contracted with the VanDepoele Mnfg. Co. to equip the road with their system. It is to be hoped, if this proves a success financially, that President Kilgour will not rest until he has electricity on all the roads belonging to the "Consolidated."

The Queen City Electric Co. will be ready in a short time to take their share of the trade in electrical supplies. They are very pleasantly located at the corner of Second and Plum streets.

The Bottled Lightning Co., corner of Sixth and Main streets, are still trying to convince the people that their battery by that name is not nearly as dangerous as the name implies. They report business on the increase.

C. H. Billings, electrician, has been awarded the contract of fitting out the New Chamber of Commerce building with the electric apparatus. This will be one of the finest buildings in the city; it stands on the corner of Fourth and Vine streets, and can not help but attract attention. M.

THE ELECTRIC LIGHT.

Articles incorporating the Cicero Water, Gas and Electric Light company, to operate at Oak Park, Ill., have been filed. The capital stock is returned at $65,000, and E. S. Conway, O. W. Herrick and W. M. Luff are named as the incorporators. Oak Park is in Cicero township, Cook county, Ill.

A special meeting of the directors of the West Side union depot at Chicago was held the 17th and arrangements perfected for illuminating the depot with electric lights.

The six towers of the electric lighting system of Mobile, Ala, were lighted up and tested September 11th by the Progress company and found to be entirely satisfactory.

Parsons, Kan., has agreed to take six street lights of the local electric light company at $96 per year each.

The city council of Columbus, Ga., has advertised for bids for electric lighting.

The Meriden, Conn., Gas company and the Meriden Electric Light company joined forces on the 1st inst. The capital stock was adjusted at $250,000, and George R. Curtis, formerly president of the gas company, was elected president of the combined new companies.

For arc lamps in the municipality of Salzbourg, the following tariff has been arranged, based upon the hour as a unit of time: 400 to 500 candles, 2.85d.; 600 to 700 candles, 4.27d; 800 to 900 candles, 5.7d.; 1,400 to 1,600 candles, 7.13d. Arc lamps are supplied only in pairs, or a single lamp is charged as for two. Carbons, if furnished by the company, are charged extra .66d. to 1.4d. per lamp per hour.

Subscriptions for 150 electric lights have been made in Holton, Kan., and the dynamos and other apparatus have been ordered by the company.

Bowersock's electric light plant at Lawrence, Kan., will be run by water power.

The officers of the Independence, Mo., Electric Light company are: A. W. Jones, president; Charles Gudgell, vice president; I. N. Rogers, treasurer; William L. McCoy, secretary; executive committee, Charles Gudgell, W. A. Cunningham, William Bryant, with the present ex-officio chairman.

The electric lights at Wellington, Kan., which have heretofore been paid for by private subscriptions, have been shut off, the city refusing to pay for them.

The new electric light plant at Red Cloud, Neb., was put in operation for the first time September 3d. Forty 2,000 candle lights illuminated the principal streets and business houses.

William Hart, an engineer of New York, one evening not long ago, noticed that one of the electric lights above the boiler had been burned out, and he climbed on the boiler to place a new globe in the lamp. He used a pair of pliers to disconnect the globe. At that time the dynamo was going at full speed. The insulating cover of the wire had been cut through, and as the pliers closed on the wire Hart received a shock that knocked him senseless. He fell backward on the boiler and lay there writhing in convulsions, until a small boy who happened to be in the engine-room called in men from Elizabeth street. They dragged him off the hot boiler, and policeman Beller ran to the Mulberry street police station to summon an ambulance. The surgeon from St. Vincent hospital worked over Hart for nearly an hour before the engineer became conscious. Before that it required the strength of several men to hold him at times, so violent were the convulsions that racked his body. When Hart was able to talk he said he felt as if a million needles were sticking into him at the moment of getting the shock. He refused to go to the hospital, but after the ambulance went away he was attacked again by convulsions that lasted over an hour. Hart had been shocked less violently on three previous occasions.

A French commission charged to investigate and report on the best means for preventing theater fires has recently published its report. The use of open flames on the stage, it states, is to be avoided; the stage decorations should be rendered incombustible by some of the well-known chemical processes; the theater should be lighted throughout by the incandescent electric light; the stage should be divided from the auditorium by a substantial wall and an iron curtain; and openings should be provided in the roof over the stage for the escape of hot gases. A recommendation is also made that the corridors and staircases should increase in width from the top to the bottom of the building, so as to provide room for the addition of crowds at every lower story in case of a general flight of spectators.

THE ELECTRIC MOTOR.

A London company has ordered 300 cars to be run by electricity instead of horse power.

Six thousand feet of electric track are used in a Lykens Valley coal mine. The weight of the train is fifty-six tons.

A great many small machines are being run by electricity in Galveston.

The Electric Traction Syndicate, limited, an English company, recently made some successful tests of running horse cars by storage batteries. The trials were made on a line, 4½ miles long, with some sharp curves and grades, at an average speed of 11½ miles per hour. The car was a small one, and carried 80 cells of 41 pounds each, or 3,280 pounds in all. The motor and frame weighed 2,240 pounds or as much as the car. The motor only—of Immisch make weighed 560 pounds. It ran at 1,000 revolutions with a current of 160 volts or 2 volts per cell and 40 ampères. The speed was geared down 1 to 10 by two chains and a countershaft. The chains had steel links united by cast steel distance pieces. The driving gear included two switches and a reversing lever. The first switch turned the entire current on, while the second altered the grouping of the cells from 80 in series to 40 in series, according as much or little power was required.

The contract has been let by the Edison Sault Ste. Marie Power & Light company for the building of a water power canal alongside the rapids of the St Mary River. The canal will be about 2,000 feet long and 50 feet wide at present. It will be widened as the demand requires. The power from this canal will be used to propel the street cars and run elevators, printing presses, electric lights, etc.

At Pullman, Ill., there is now being built an electric locomotive which will be equipped with a motor of the Van Depoele Electric Manufg. Co's make, and which will be used to handle freight on the Derby Horse railroad between Birmingham and Ansonia, Conn. J. B. Wallace, president of the Electrical Supply company, is also president of the Derby Horse railroad company. The motor will be geared to the driving wheels of the locomotive, and in this respect will differ from the usual method, which is to transmit the motion of the motor to the driving wheels by means of a chain belt over sprocket-wheels.

St. Catherines, Ont., put its electric street railway in operation this week. The line is equipped with ten 15 horse power motors.

The Capital city street railway of Montgomery Ala., in addition to running its cars by electric motors and lighting its lines by the electric light, will provide motors for small powers.

In a coal mine near Normanton, England, the motive power for pumping water to the surface was furnished by compressed air, but on account of the low efficiency electric motors were substituted.

THE TELEPHONE.

The Kansas City Telephone exchange is in straits—of having more orders than it can fill. Throughout the year the continued growth of the business of this exchange has been amazing.

A Baltimore dispatch dated the 17th says that a suit, which it is believed is intended to shut off Count Mitkiewicz's Chinese telephone scheme, has been entered by the American Bell Telephone company in the United States circuit court of this city against William E. Turnbull, the inventor of the long-distance telephone. The judge of court upon the bill in equity filed by the Bell company to-day signed an order providing that until the hearing of the motion the defendant is restrained from directly or indirectly making, using or furnishing to others for use any electric speaking telephones or telephonic apparatus whatever, embracing and embodying the inventions and improvements, or any material parts thereof, claimed in the letters patent of the complainant corporation granted to Bell. November 1st is fixed for the hearing.

A clever swindle has been perpetrated on the Palace hotel and the Burnet house of Cincinnati. Telephone messages, ostensibly from regular boarders at the hotels, were received, directing the clerks to pay for packages addressed to the boarders, which, it was said, would be sent to the hotels. The swindler told the clerk of the Palace hotel that Fred Kinsinger was talking to him, and at the Burnet house the name of Fred Weir was used. The package addressed to Mr. Kinsinger was accompanied by a bill for $52 and that sent Mr. Weir by a bill for $54. The money was paid in both instances. An unsuccessful attempt was made to swindle the Gibson house in the same way.

The system of telephones in use in Greensburg, Ind., has changed hands, Oscar Hand, of Shelbyville, now being proprietor. John Forsyth, of the former place, has been made superintendent of the business in Greensburg, and will devote himself to the interests of his patrons.

Michael H. McGovern of Chicago has began suit against the Chicago Telephone company and the Western Union Telegraph company. McGovern is a fireman and he alleges that at a recent fire he was working in the ruins with about twenty comrades endeavoring to dig out a man who was terribly injured, when a part of the roof became detached by the working of the cables of the defendant companies in the hands of some telegraph men who were trying to cut or loosen them. They had been previously ordered off by both police and firemen, according to the plaintiff, but had crept back again. The falling roof struck McGovern in the back, cutting him deeply and injuring him for life.

The Lancashire & Cheshire Telephonic Exchange company, limited, of Manchester, Eng., at the close of the year ending June 30th last, show a balance to the credit of the net revenue account of £14,212.

The Cushman telephone system at Elkhart, Ind., was put in running order the early part of this week with 75 subscribers. At Findlay, O., there are 65 subscribers; at Wahpeton, D. T., 60 subscribers, and at La Porte, Ind., 49 subscribers.

The mechanical telephone which we briefly alluded to in a recent issue, is known as the pulsion telephone, and is the invention of Jerome Prince and Lemuel Mellett, of Milford, Mass. It is operated without electricity by a very ingenious transmitter, and a number 18, taut copper wire. Experiments on a line 1,600 feet long, with a hat as a receiver, gave the very best results, which were not in the least affected by external contacts with the line wire; conversation being distinctly heard in the open air, out of doors, at a distance of one-third of a mile from the speaker, and 60 feet from the receiver; a brisk wind at the time blowing on the wire; the hat being merely placed against the wire, the end of which lay on the ground. A second test, indoors, between two buildings, gave results equally satisfactory, conversation in the ordinary tone being heard distinctly in every part of the room, and down stairs at a distance of 40 feet; and whispering, singing, and instrumental music being also heard with great clearness. The transmitter contains a device for imparting to the tones of the voice a peculiar vibratory force, not only persistent as against other forces, but easily controlled. Lines are to be constructed from Milford to North Milford, Hopedale and Upton, and subjected to the most rigid tests before general use.

THE TELEGRAPH.

A scientific gentleman of Berlin attempts to prove by certain documents that in 1809 Sœmmering, then professor at Munich, had established in that city by the aid of the voltaic battery telegraphic communication which worked quite satisfactorily. The celebrated surgeon Larrey, who was connected with Sœmmering made known to Napoleon I. this invention in 1809, but this great genius who had already refused to admit the possibly of steam navigation, rejected as a dream the invention of the electric telegraph. There is some resemblance betweenNapoleon I. and M. Thiers, who would not believe for a long time in the practicability of the railroads.

Along the route of the parade at the Philadelphia celebration last week, there were sixteen telegraph stations which aided much in handling the immense procession.

About two hundred persons met at the Masonic temple in New York Sunday, in response to a call for a mass-meeting of telegraphers, line-men, and others employed by electrical companies. Henry George addressed them, urging them to support the united labor party, after which resolutions were adopted favoring the united labor party and approving the Syracuse platform. Dr. McGlynn then spoke and was heartly received. He expounded the party's principles, but as soon as he got through a general exodus took place before a speaker to stump the state was selected.

M. Prisiajirikov, chief of the posts and telegraphs in Samara, Russia, has introduced a method of soldering telegraph wires, which consists in the use of a heating tool, capable of holding a considerable quantity of melted solder, and

upon the top of this is thrown sufficient powdered sal ammoniac to leave a layer of liquid salt of some little depth. This liquid is nearly black in color. The iron wire already covered with binding wire is then pressed underneath the surface of the melted solder passing through the liquid salt. This effects a perfect solder, no matter how dirty the wire may be.

At the regular meeting of the executive committee of the Western Union Telegraph company, September 13th, it was decided to recommend to the directors to declare a dividend of 1 per cent.

An exchange announces the death of Henry W. Wynkoop, superintendent of telegraph of the Pennsylvania lines west of Pittsburgh. His death occured suddenly at his residence in Crestline, Ohio, Friday afternoon, September 11th. He was a fine electrician, and one of the oldest telegraphers in the country.

NEW ENTERPRISES.

William Meredith, of 912 East Second street, Kansas City, Mo., is about to build a $6,000 residence. He will put in electric bells.

K. L. Barton, of the same city, will build a two-story residence to cost $25,000. It will be heated by steam and supplied with electric appliances.

G. G. Sass, of 6 East Fourth street, of the same city, is about to build a $9,000 residence, which will also be provided with electric bells.

The Kinkade Memorial Church Society, of Girard, Kans., will erect a new church edifice at a cost of $20,000.

Milton Welch, of 12 Underwriter's Exchange, Kansas City, Mo., will put up a three-story residence to cost $6,500. It will be provided with electric bells.

The city of Yankton, D. T., is about to erect a new city hall to cost $12,000. E. W. Loft, of Sioux City, Ia., is the architect.

Massillon, Ohio, is to have a fire alarm telegraph system. It is prescribed that the system is "to consist of fifteen non-interfering closed circuit boxes, which shall contain a Stover test switch board, whereby each box can be tested both mechanically and electrically, tapping its own number within itself without striking the engine house apparatus; also, one fifteen inch combined gong and indicator for engine house, and one six inch mechanical tapper for the chief engineer, with sufficient battery and all other attachments, with from ten to fifteen miles of wire." J. K. White, whose address is at the Union National bank, is city clerk.

James Anderson, of Oak street, Kansas City, Mo., will put up a three-story residence to cost $4,000. It will be fitted with electric appliances.

The Lindsburg Hotel company, of Lindsburg, Kan., will build a new hotel of three stories to cost $18,000. It will be fitted with electric bells and other electric apparatus.

M. R. Wright, of Independence, Mo., is to build a three-story residence to cost $6,000. It will be provided with electric bells.

Miscellaneous Notes.

Thirty-two miles an hour was made by the torpedo steamer built by Thorneycroft, of Chiswick, England, mention of which has heretofore been made in this column.

During the past week some interesting experiments have been made at Lydd camp with the electric search light. It was desired to work the light under the fire of the rifles and the Gardner guns of an enemy. The engine and apparatus which worked the light were placed under a casemate about 200 yards from where the light was actually seen. The light was so arranged as to be under cover and to throw the rays on to a reflector on the top of a parapet, by means of which the country round was scoured under a shower of bullets fired at it. The reflecting disc had a diameter of 26 in., and it was found that although it was struck by bullets several times the damage was practically *nil*, the reflecting power being only diminished by the area of bullet holes. The reflector was worked by four temporary guy ropes, divided equally round its surface, two to give depression or elevation and the other two for lateral direction, all these movements being worked from the casemate. The difficulty in shooting at this bright light was found to be very great indeed. Aim could only be taken through a dark piece of oiled paper placed over the foresight. Ten marksmen of the East Surrey regiment and a Gardner gun were brought to bear upon the light. Several hundred rounds were fired at 1,000 yards and 600 yards. It was found after two hours' sharp firing that the reflector had been struck fifteen times without being seriously damaged. The light was shown at intervals of about a minute only.—*London Electrician.*

The experiments made by M. Mohlenbruch seem to show that in the mesmeric condition an electric current may have a powerful inductive action upon the human nerves. These experiments were made, as reported, with an apparatus consisting of a ring of iron wires wound with silk-covered copper, the latter being placed in circuit with a microphone and a battery cell. The ring was about nine inches in diameter. In the first experiment a watch was placed near the microphone and the ring placed upon the head of the mesmerized subject, who immediately began to beat time with the ticking of the watch. When the microphone contact was touched with a quill feather he placed his finger in his ears, and on the microphone being removed to a distant apartment and the connection of the circuit completed, as before, a violin was placed in the distant room, the patient showing the most distinct indications that he heard the music. The next experiment was obviously to speak to the microphone, "and to my great surprise," says M. Mohlenbruch, "the patient repeated the words." The last experiment was to send a continuous current through the circuit, which had the effect of causing the patient to throw his arms around in a circle in a vertical plane—the direction of motion being reversed with the reversal of the current—and when the patient was asked what he felt like he said he was turning.

"I've got a new scheme," said the manager of a Chicago restaurant to a reporter. "I don't know how it is with you, but it takes away my appetite to go into a restaurant where the waiter, when he gets your order, bawls it out at the top of his voice. Now, in some places, after ordering ham and eggs as you did, you'd hear the waiter shout, 'One in the dark, white wings, hog to come along,' and if you told him you wanted the eggs cooked on both sides he'd sing out, 'Shipwreck them white wings.' Of course, the cook understands that ham an eggs and a cup of coffee are the articles called for by this order, but to the unitiated it is all Greek. Waiters' slang is the most complex jargon ever used, and why they use it they are unable to explain themselves. Now, by my system all the noise and confusion are done away with. You never hear an order given, and the waiters are not obliged to leave the dining-room. But come with me and I'll show you." The manager led the way to a table near the center of the room. Upon it were about twenty white buttons and at the base of each was a label. Every button was capable of transmitting several orders. For instance one of the buttons was labeled "eggs," and upon a card were the following directions: "For boiled eggs, ring once; eggs on toast, twice; scrambled eggs, three times; omelet, four times." It was the same with steaks, as by a different number of rings the distinction between tenderloin, porterhouse, and sirloin, rare, medium or well done could be conveyed to the kitchen with as much accuracy by the voice and with more speed. "We'll go down to the kitchen and see how that end of it works," remarked the manager, leading the way to a flight of stairs. A savory smell of cooking meat was wafted to the visitor as he descended the stairs. In front of half a dozen big broilers stood as many white jacketed cooks with equally white caps placed rakishly upon their heads. Opposite the ranges, surrounded by a little railing, was an annunciator resembling those used in hotels to denote the numbers of the rooms. In front of it was seated a lad about fifteen years of age with a number of tickets in his hand. Each ticket had a number printed upon it corresponding with the number given one of the cooks. These were called off in rotation, so that each one of the cooks would get the same number of dishes to serve. Suddenly there was a whirring sound, followed by a quick snap. The boy looked up and saw imprinted on the section of the annunciator disclosed by the drop, "steak." Then came two short rings and a long one. The boy looked at a card and called: "Number 3, tenderloin steak rare, with mushrooms." The triangular piece of metal was put back in its place, and in a trice a juicy steak was sizzling on the iron. It was getting along toward six o'clock then, and the orders began to come in thick and fast. "We don't serve anything here but short orders," said the manager, "and, though I have over fifty articles on my bill of fare, I have never found one that could not be ordered by means of the bell. I don't believe there's another system like it in the country, and you can see for yourself how much time and trouble it saves."

Prof. John Tyndall writes to *The Times* of London: Your recent remarks on thunderstorms and their effects induce me to submit to you the following facts and considerations. Some years ago a rock lighthouse on the coast of Ireland was struck and damaged by lightning. An engineer was sent down to report on the occurence, and as I then held the honorable and responsible post as scientific adviser to the Trinity house and board of trade, the report was submitted to me. The lightning-conductor had been carried down the light-house tower, its lower extremity being carefully imbedded in a stone perforated to receive it. If the object had been to invite the lightning to strike the tower a better arrangement could hardly have been adopted. I gave directions to have the conductor immediately prolonged, and to have added to it a large terminal plate of copper, which was to be completely submerged in the sea. The obvious convenience of a chain as a prolongation of the conductor caused the authorities in Ireland to propose it, but I was obliged to veto the adoption of the chain. The contact of link with link is never perfect. I had, moreover, beside me a portion of a chain cable through which a lightning discharge had passed, the electricity in passing from link to link encountering a resistance sufficient to enable it to partly fuse the chain. The abolition of resistance is absolutely necessary in connecting a lightning conductor with the earth, and this is done by closely imbedding in the earth a plate of good conducting material and of large area. The largeness of area makes atonement for the imperfect conductivity of earth, The plate, in fact, constitutes a wide door through which the electricity passes freely into the earth, its disruptive and damaging effects being thereby avoided. These truths are elementary, but they are often neglected. I watched with interest some time ago the operation of setting up a lightning conductor on the house of a neighbor of mine in the country. The wire rope, which formed part of the conductor, was carried down the wall and comfortably laid in the earth below without any terminal plate whatever. I expostulated with the man who did the work, but he obviously thought he knew more about the matter than I did. I am credibly informed that this a common way of dealing with lightning conductors by ignorant practitioners, and the bishop of Winchester's palace at Farnham has been mentioned to me as an edifice "protected" in this fashion. If my informant be correct, the "protection" is a mockery, a delusion and a snare.

Charles F. Imbrie, of New York, well-known for his devotion to piscatorial pursuits, says that while fishing in the Grand river he saw some salmon struck by lightning. He was fishing in the largest pool of the river, known as the grand pool. The day was very hot and perfectly still, and it was not possible to raise a fish. Suddenly one of those regular Canadian river thunder storms set in, and as it was dangerous to stand under the trees, Mr. Imbrie took up a position at the foot of the pool. He thus had a fair and full view of the entire sheet of water. The lightning flashes came nearer and nearer, and presently there was a perfectly blinding flash instantly accompanied by severe thunder. The whole air seemed to be on fire. Feeling certain that something must have been struck, Mr. Imbrie looked about him to see what tall tree or

trees had fallen. To his surprise there was no evidence of the lightning having struck anything. After a moment or two he saw several salmon flopping about in the water in a most curious and unaccountable way. Soon one of them floated down to the end of the pool where he was standing, and although it quivered somewhat, it was practically dead. Two more soon floated down. Mr. Imbrie and his gaffers took them ashore, and before leaving the pool had secured seven salmon in the condition spoken of. Upon cutting open the fish it was found that the blood along their backbone was congested, otherwise there was not the slightest mark of any injury done to them.

The new iron curtain of the Theater Francais is a gigantic affair. It neither rolls up nor folds together, but ascends in a solid sheet into the upper regions, which have had to be heightened to make room for it. The ascent occupies a minute and a quarter. It appears, too, that the new drop scene, with its colonnade and busts, is not an ordinary rolling canvas, but is glued to the iron curtain.

The treasury department at Washington is to be provided with the most efficient system of fire alarm obtainable. At present the department depends for the suppression of fire in its incipiency upon the men and apparatus within the building. The engines are kept running all through the night, but Chief-clerk Youmans thinks that such a system, except in the hands of trained firemen, is unreliable. It is proposed to put in an electric system of alarms connecting with the district fire department, and have it so arranged that when the alarm is sounded, if it reaches the fire department, an immediate answer will be returned. A watchman's detector, for recording the rounds of the watchmen and the time they visit different points in the building at night, will be connected with the fire alarm system.

The question as to the probability of the gas wells giving out at some time in the near future has been canvassed again recently by a party of coal operators and scientific men from Pittsburg, who took a somewhat extended trip through the Monongahela oil-producing district for purposes of exploration. They returned convinced that there was a great falling off from the rate of flow of a year ago in most of the wells, and that the general failing of the gas wells was only a matter of a few years. Many of the wells are still up to their old mark, and many more are giving forth good amounts, but the total yield, they say, has largely decreased and is now decreasing. As this party was largely composed of operators in coal lands their statements have been naturally discounted considerably by those interested in gas wells, and, in fact, these latter just as confidently assert that there has been no sensible diminution in the flow of gas.

Personal Paragraphs.

J. W. Ebert, manager of the Kansas City telephone exchange, called on a few friends in Chicago last Saturday. He was on his way to New York.

James L. Grose, manager of the telephone exchange at Joliet, was united in marriage, on the 17th inst., to Miss Adelaide R. Gregory. The happy couple, after spending a day in Chicago, left for an extended southern trip.

F. J. Sprague, vice-president and general manager of the Sprague Electric Railway & Motor Co., passed through Chicago early this week. He is on his way west, seeking recuperation from a servere attack of typhoid fever. H. Mc. L. Harding, general agent of the company, accompanied Mr. Sprague.

Chas. D. Shain, of the United States Electric Lighting company, returned to Chicago, Monday, from a fortnight's vacation spent in the east.

H. Ward Leonard, of Leonard & Izard, Chicago, has recovered from the injury which kept him confined to the house for some days, and last Monday resumed work at the office.

Gen. A. K. Stiles, of the Van Depoele Electric Manfg. Co., Chicago, is in the east.

Business Mention.

Munson & Co., manufacturers of leather belting, have been experiencing such a heavy business during the present season that they find their present quarters at 240 and 242 Randolph street, Chicago, too small for their requirements, and are making preparations to go into a larger building at the corner of Canal and Washington streets. In their new quarters they will have about double their present capacity, and are now negotiating for six extra hydraulic presses and other machinery to be used in the manufacture of belting. The firm expect to move within a month.

The Western Electric company of Chicago has received another order for a thirty-light machine for St. Louis. This will increase the capacity of that plant to about 100 lights.

The combination of gas and electric lighting is making very rapid progress, and it is understood that the results are proving very satisfactory to the gas companies which have taken up the idea of combination. Recently the Oswego Gas company, of Oswego, N. Y., decided upon going into the electric business and gave the American company a contract for 50 lights.

The organization of a new company to be called the Van Depoele Electric Railway & Power company is under way and well-nigh consummated. The capital stock will be $2,000,000, and it is the intention to erect a new factory in Chicago at a cost of $500,000. The new company will purchase the street railway and motor plant of the Van Depoele Electric Mnfg. company of Chicago, and will confine itself to that department of the business. The extent of the business of the latter company is so vast that a division was deemed advisable, the idea being to separate the motor department from the electric light department.

The Police Telephone & Signal company of Chicago has put in a complete equipment of its system at Fort Wayne, Ind.

The Van Depoele Electric Mnfg. Co. of Chicago has received orders for a sixty-light arc dynamo from the Capital City Street Railway company of Montgomery, Ala., to light Highland, a suburb; another outfit of the same size from the Scranton, Penn., street railway company to light their line and also Dunmore, an addition to Scranton, and a ten-light plant from the Goss Printing Press company of West Lake street, Chicago.

The White Line street railway of Dayton, O., is to be equipped with about twenty-five electric motors of the Van Depoele Electric Mnfg. Co.'s make. John Kilgour of Cincinnati, is at the head of the enterprise. About six miles of overhead wire and one mile of underground conduit will be required.

At the Pittsburgh telephone convention next week, a small section of the new style multiple switch board made by the Western Electric company will be exhibited.

An additional section of multiple switch board has been ordered by the Minneapolis exchange of the Western Electric company. This section will bring the equipment of the exchange up to 1,400.

The Central Electric company of Chicago is putting in a 100-drop annunciator in a new hotel erected by the Dakota Improvement company at Fargo, D. T.

C. M. Barclay, western agent for the Sprague Motor company, reports the recent installations of stationary Sprague motors: Elgin, Ill., three one-half horse power motors; La Crosse, Wis., two one-half horse power motors; St. Paul, Minn., three one horse power motors; Peoria, Ill., *Democrat and Post Review*, one five horse power motor; Peoria, Ill., Hill Publishing company, one five horse power motor, and in Chicago, Myer & Goodman, one horse power motor for ventilating; Lansing & Sickler, one horse power motor for ventilating; "The Fair," one horse power motor for driving coffee mill; American Exchange national bank, one horse power motor for driving a 30-inch Blackman fan.

Leonard & Izard, for the Edison company, have recently installed a plant of 160 lights for N. S. Murphy of Green Bay, Wis.; 500 lights for the Chicago & Northwestern Railway shops in Chicago and 250 lights for the shops at Winona, Minn.; 500 lights for the People's theater at Minneapolis, Minn.; a central station of 600 lights at Jamestown, D. T.; a central station of 600 lights at Decatur, Ill.; 800 lights for the Chicago, Burlington & Quincy R.R. office building; 500 lights for the Murray building, Omaha; an enlargement of 375 lights to the central station at Baraboo, Wis.; 100 lights for the Owatonna state schools; 500 lights for Armour & Co. at the stockyards, and have taken a contract for a street system at Jerseyville, Ill.

The street system of Edison lights at Oskaloosa, Ia., put in by Leonard & Izard of Chicago, was started the 15th inst., to the eminent satisfaction of all interested.

Electrical Patents.

Issued September 13, 1887.

369,754. Dynamo Electric Machine or Motor. Elihu Thomson, Lynn, Mass. The opposing cores of the field magnet are wound so that one will be normally saturated and the other only feebly magnetized. The saturated pole is magnetized to oppose and normally overcome the feebly magnetized core. That is to say, the pole of the feebly magnetized core presented towards the pole of the saturated core tends to cut down the magnetism of the latter. The coils may be connected in series or in multiple. The object of the invention is to maintain a uniform current strength in a circuit in which the resistance is not uniform.

369,769. Galvanic Battery. Horatio J. Brewer, New York, N. Y.

369,793. Manufacture of Insulated Electrical Conductors. John T. Jacques, Boston, Mass. The claim defines the invention as follows: "The process of insulating an electrical conductor herein described, which consists in covering the conductor with a fibrous insulating material, subjecting it to the combined action of heat and an air pump operated to produce a vacuum until the combined action thereof bursts the cellular structure of the fibrous insulating material and dispels the moisture, and then applying insulating substance under pressure."

369,801. Electric Valve Controller. William H. Markland, Brooklyn, N. Y.

369,808. Electric Call Bell. Joseph G. Noyes, New York, N. Y. "The invention consists in combining the clapper of an electric bell with a shell or dust-cap, made in one piece, surrounding the armature and the electro-magnet, the clapper projecting through said dust-cap. This dust-cap carries the bell, which is rigidly secured thereto. The said bell is also provided with a second clapper, which may be operated by hand."

369,810. Electrical Annunciator Call System. F. Jarvis Patten, Fort Sidney, Nebraska.

369,813. Underground Conduit for Electric Wires. Gustav Rader, New York, N. Y.

369,867. Automatic Rosette Engine. Edward A. Marsh, Newton, Mass.

369,880. Railway Telegraph. Lucius J. Phelps, New York, N. Y. The invention consists in the combination, with a telegraph line, of a railway inductive signaling apparatus consisting of induction devices carried on a railway car or vehicle in proximity to the line and a suitable station provided with apparatus for placing induction impulses onto and receiving them from said line, and continuity-preserving transmitters for the ordinary telegraph stations on the telegraph line, said continuity-preserving transmitters operating to preserve the circuit for the induction signals.

369,889. Electrical Cut-Out. Nolton F. Stoddard, Detroit, Mich.

369,915. Lightning Conductor. William Brown, Duncannon, Pa.

369,917. Governor for Electro-Magnetic Brake Circuits. George F. Card, Covington, Ky.

369,929. Electric Railway Signal. J. Hamilton Farrar, Chicago, Ill.

369,954. Automatic Reverse Movement and Spacing Mechanism for Electrical and Mechanical Type-Writers. James F. McLaughlin, Philadelphia, Pa.

369,989. Electric Bell. Hans P. F. Jensen, Browne W. Webb and Jens Jensen, London, England.

370,000. Regulation of Electric Motors. Schuyler S. Wheeler, New York, N. Y. The invention relates to motors run with other motors or connecting devices. Its object is to regulate the power and speed of the motor at will without unnecessary loss of energy. No special shunt or regulating apparatus external to the motor is required; and resistance in the circuit with consequent loss of energy is avoided. The invention consists broadly in an electric motor with its armature in line and its field magnet connected in multiple arc with said armature with a manual switch arranged to shunt any number or all of the coils of the field magnet. Several obvious forms of the switch and different methods of winding the field magnets are shown.

370,007. Electric Heat-Regulating Apparatus. William A. Connely, Boston, Mass. The steam valves are closed and opened by an electric motor through which current is sent in one direction or the other, according as the temperature rises above or falls below the normal.

Re-Issue — 10,866. Apparatus for Making Carbons. John T. Lester, Cleveland, Ohio. The apparatus and method are well covered by twenty-three claims. The carbons are removed from the press hot, and while hot, the webs uniting them are severed and the points formed, machinery being substituted for hand work.

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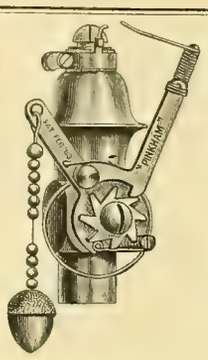

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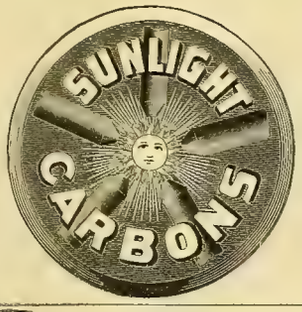

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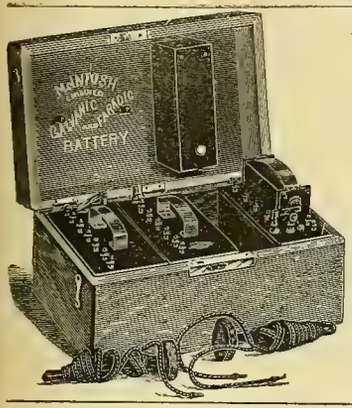

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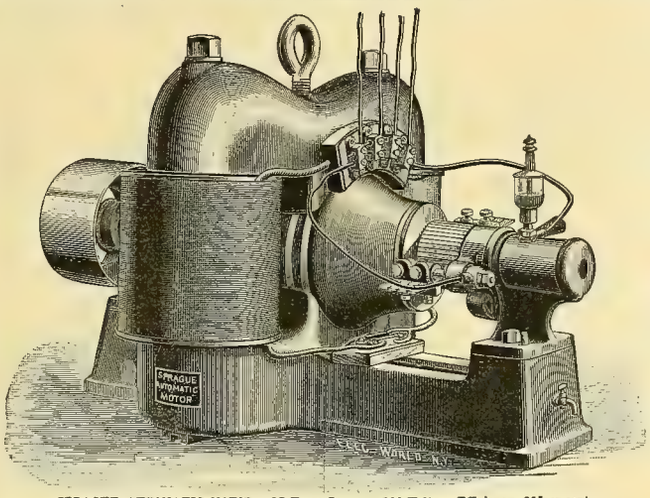

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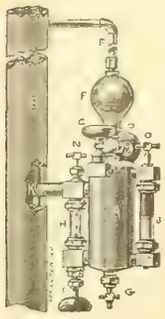

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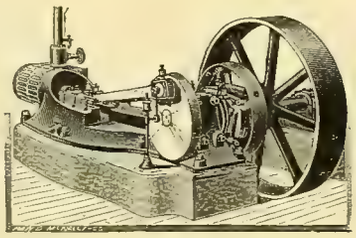

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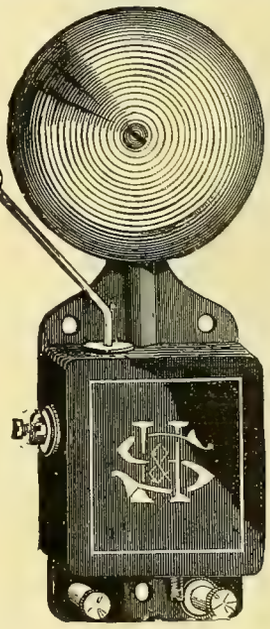

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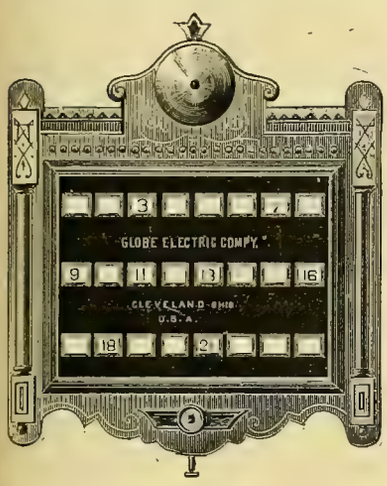

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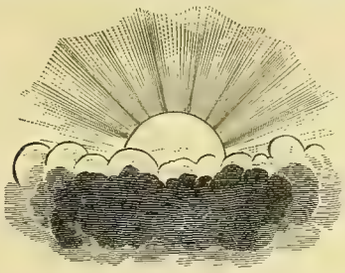

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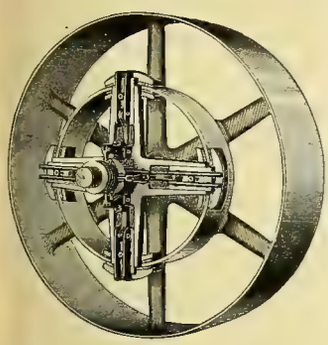

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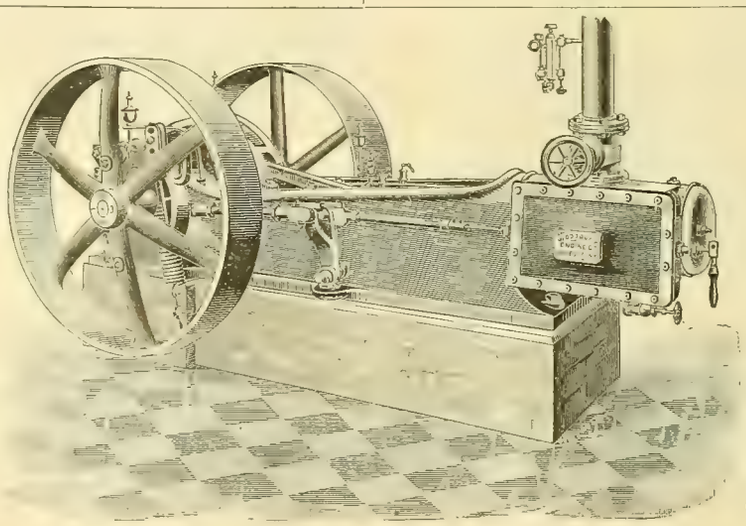

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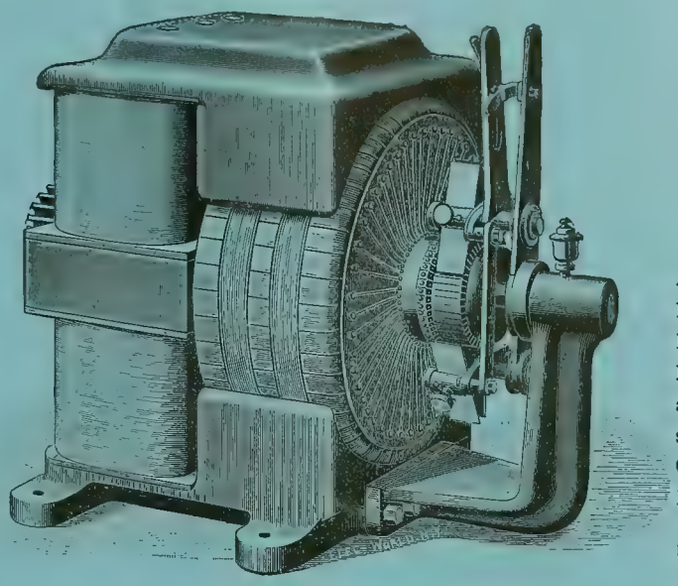

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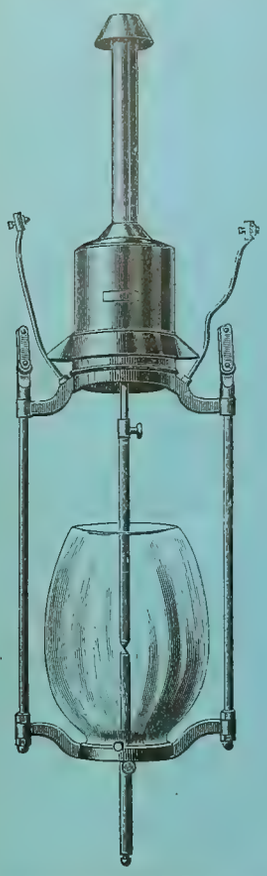

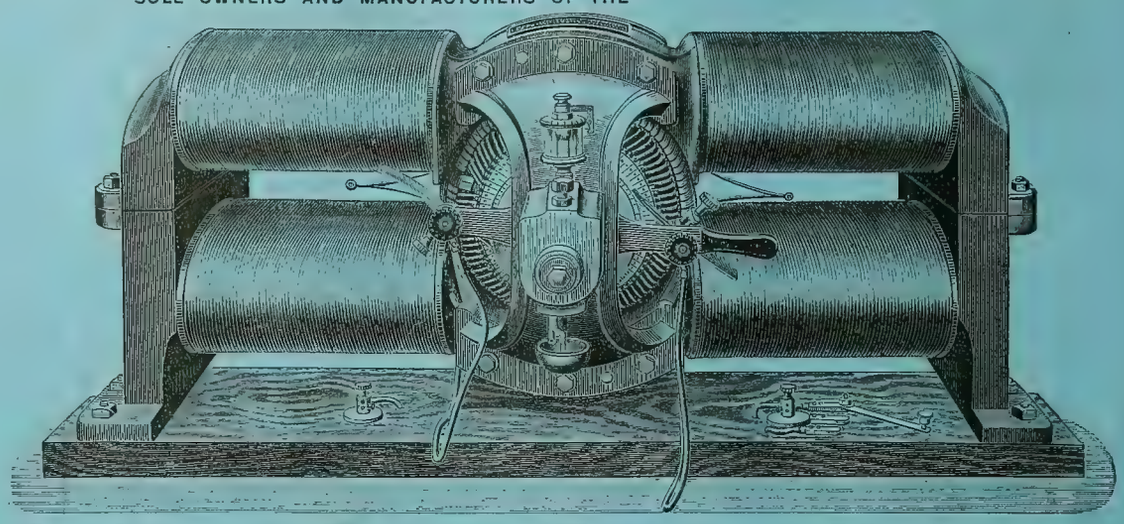

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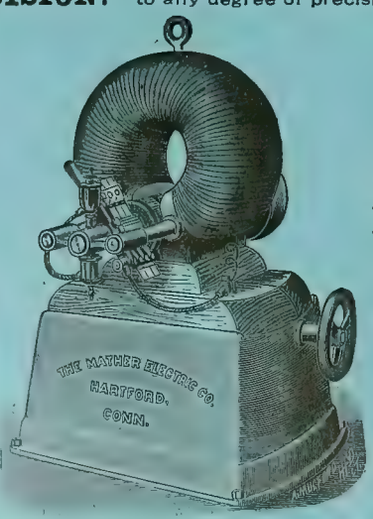

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Western Electrician.

EVERY SATURDAY.

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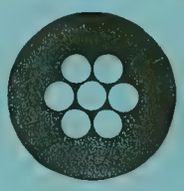

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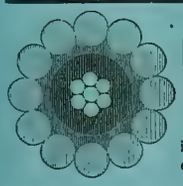

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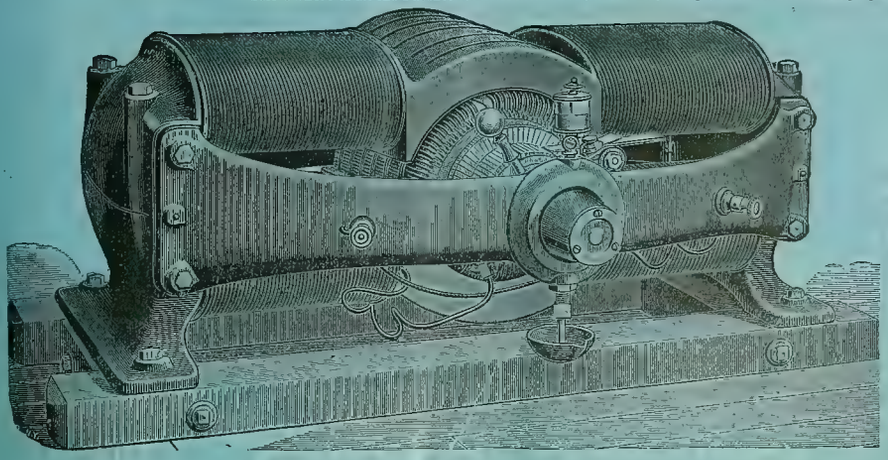

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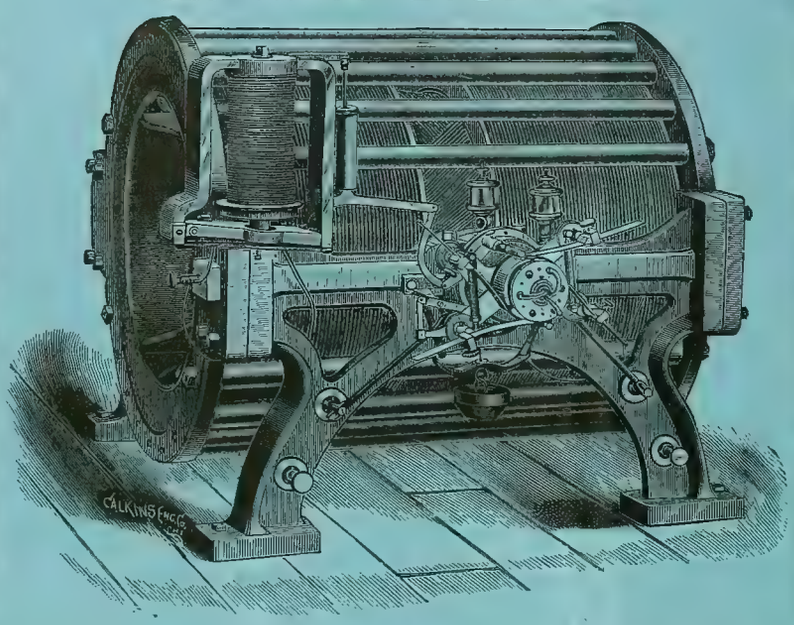

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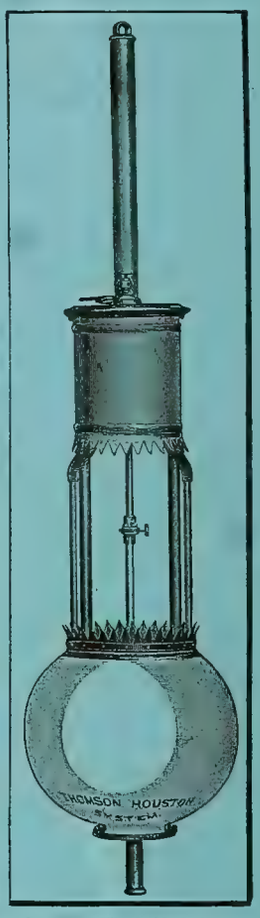

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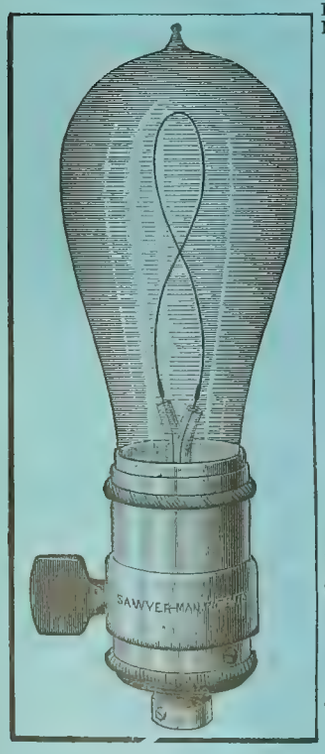

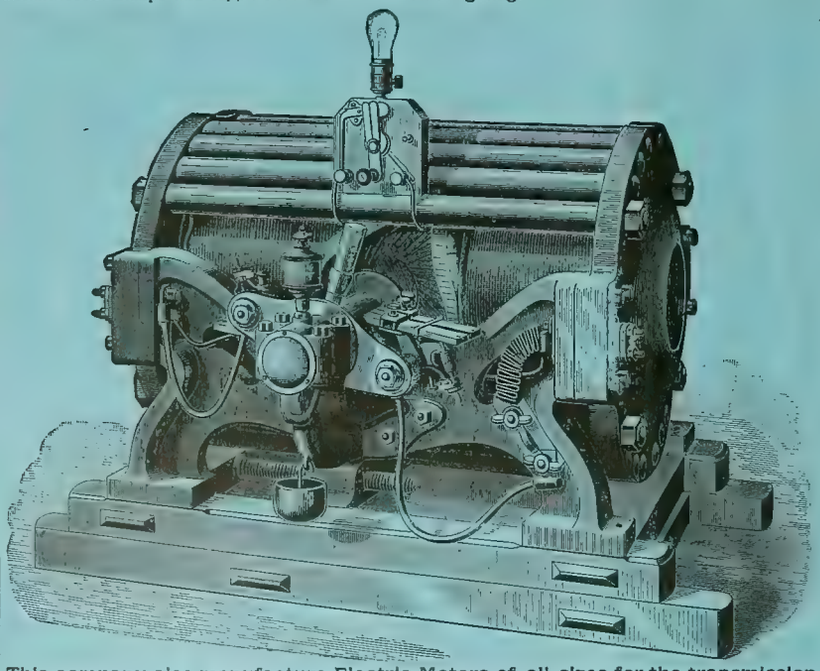

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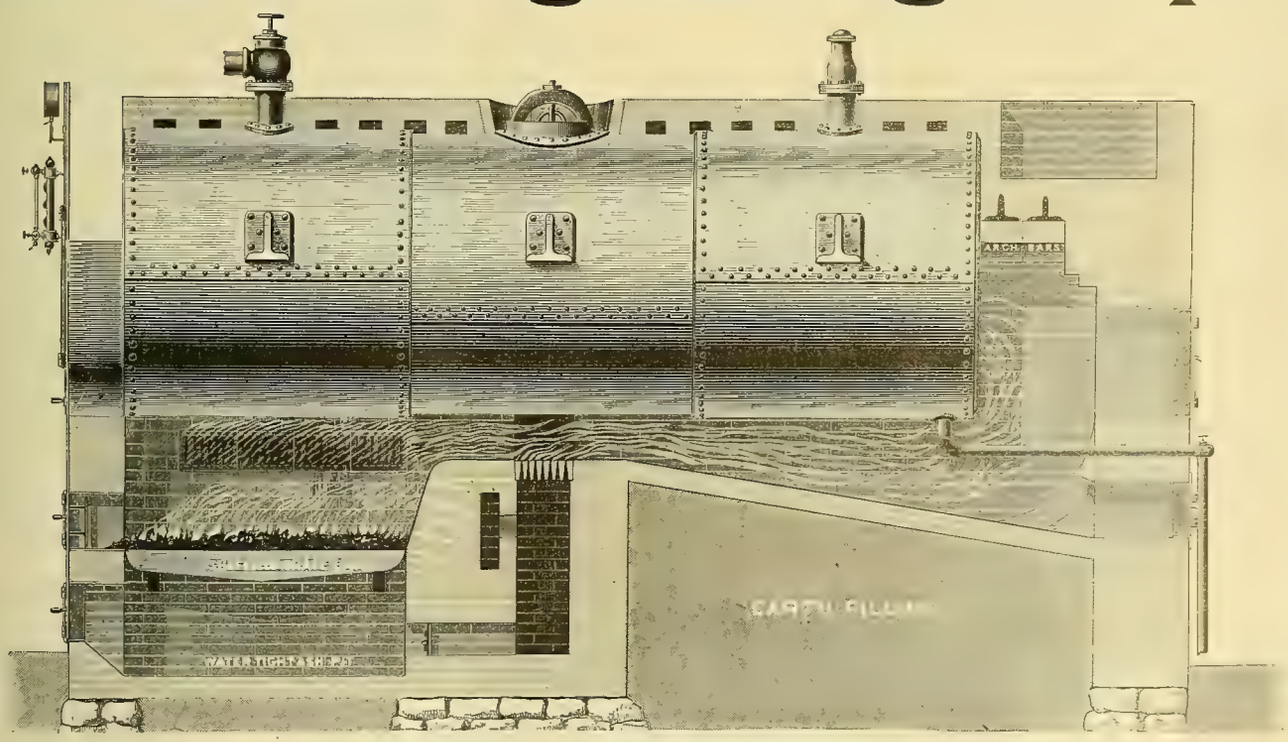

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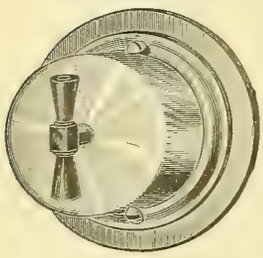

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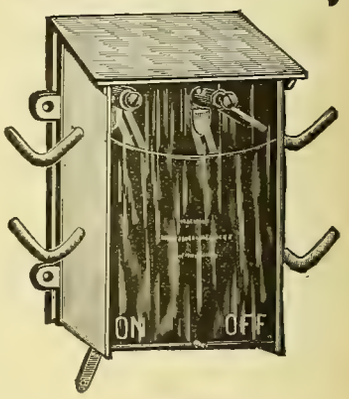

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CAPACITY, 1,000,000 CARBONS MONTHLY.

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NEW ✻ YORK ✻ SAFETY ✻ STEAM ✻ POWER ✻ CO.

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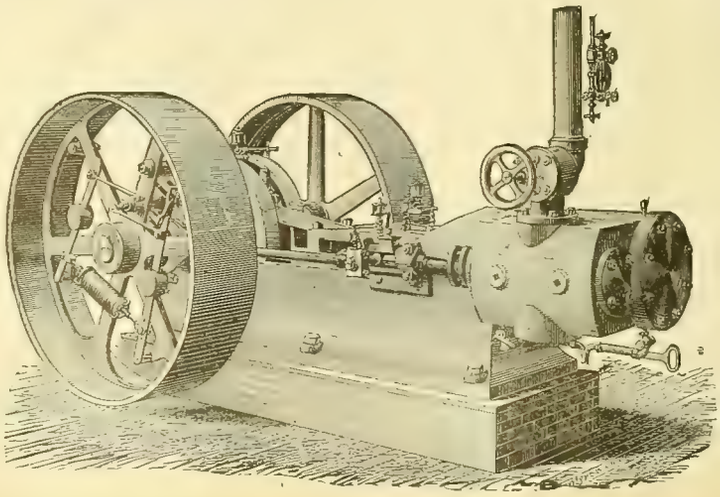
AUTOMATIC

Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC LIGHTS

And other duty requiring close regulation of speed.



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Great strength without excessive weight,
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Complete Steam Plants for Electric Light and Power.

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Underwriters' Copper Electric Light Line Wire, handsomely finished highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

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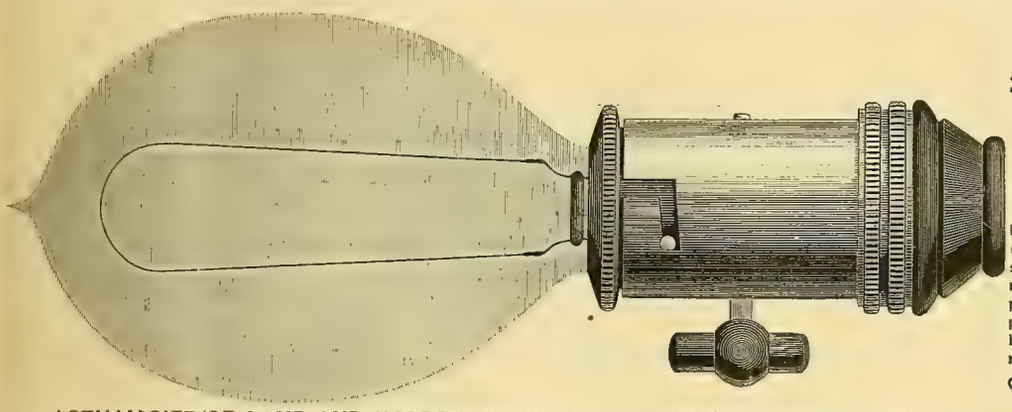

ACTUAL SIZE OF LAMP AND HOLDER (Size No. 1,) FOR LAMPS 65 to 100 V. 16 C. P.

Aluminous Incandescent.

We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

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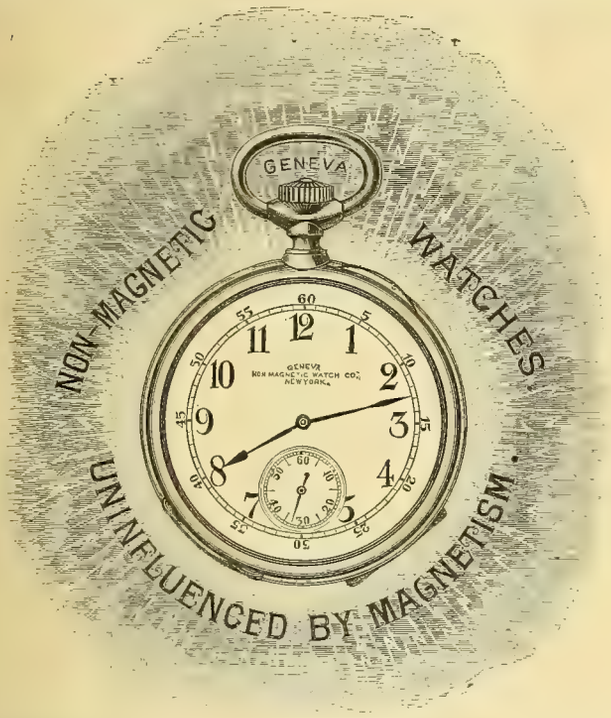

Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode. Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the *works*, they require no shield or other protection.

Ask your jeweler for them. Send for Catalogue.

Geneva Non-Magnetic Watch Co., L'd.

177 and 179 Broadway, NEW YORK.

The National Conduit Mfg. Co's

Cement-lined Underground Conduit is the Cheapest and Best Conduit known.

Made of the Best Wrought Iron and Pure Cement.

25 MILES NOW BEING LAID IN NEW YORK CITY.

ADDRESS:

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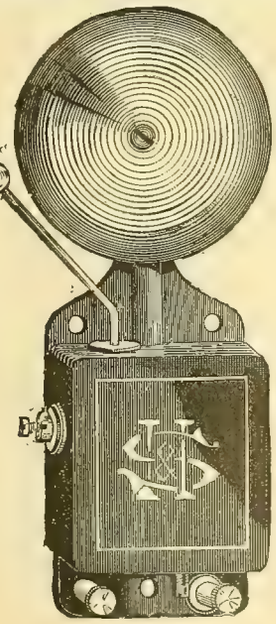
HAZAZER & STANLEY,

Dust-Proof

Superior to all others.



Electric BELLS

32 & 34 Frankfort St.

NEW YORK.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

Telegraph and Telephone Apparatus and Supplies

THE BEST OF EVERYTHING AT BOTTOM PRICES.

DETROIT ELECTRICAL WORKS,

MANUFACTURERS OF

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INCLUDING

Medical Batteries, Skeleton, Iron and Box Bells, Burglar Alarms, Hotel and House Annunciators, Fire Alarm Boxes, Pins and Brackets, Insulated, Magnet, Telephone and Electric Light Wire.

BUILDERS OF

Fisher's Electric Motors,

AND ALL APPLIANCES FOR CITY AND SUBURBAN

ELECTRIC RAILWAYS.

General Offices and Works, - - DETROIT, MICHIGAN.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARNER.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening-. We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warner
MANAGER WESTERN DEPARTMENT,
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously installed by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volt.
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348.
What amount of power was required to run the 348 lights?	54 H.P.
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 600 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 H.P.

C. C. Warner Esq.
Dear Sir. I have written the answers opposite your questions above as per your request, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.
Yours truly, J. F. Conklin

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARNER, Manager Western Department, 216 La Salle St., Chicago.

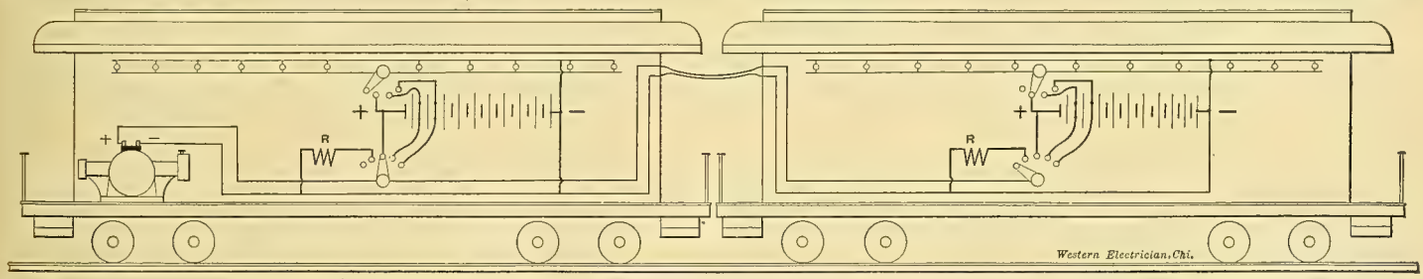
Western Electrician.

EVERY SATURDAY.

Vol. I. CHICAGO, OCTOBER 1, 1887. No. 14.

The Presidential Train.

The train of railroad cars in which President and Mrs. Cleveland are making their western and southern trip, is perhaps the most luxuriously equipped of any train in the world. It consists of three cars. The first and second have been taken from the famous vestibule train known as the "New York and Chicago limited," running between those two cities on the Pennsylvania road, and the third is the private car of George M. Pullman, president of the Pullman Palace Car company. The first car is known as the "Alafretta" and is a composite car; the forward end is devoted to baggage; immediately in the rear of this is a library, by the way, as elegant and well appointed as any private library, and still further in the rear is a bath-room and barber shop. The "Velasco," a sleeper with all the comforts that art could suggest is the second car. The "P.P.C.," for under these three letters president Pullman's private car goes, is the third of these magnificent cars, and during this trip it is devoted to the exclusive use of President and Mrs. Cleveland. This car has been refinished on the outside in the standard Pullman colors, olive and gold, and the inside finish is of the combination type, so called because several different woods are used for the interior decoration. The rear end of this car is used as an observation-room, and through its broad plate glass windows an excellent view of the scenery can be obtained.



This appartment is luxuriously furnished in mahogany and upholstered in blue glass plush. Next to this are the sleeping and dressing rooms, which will be occupied by the president and Mrs. Cleveland. They are daintily furnished in white satin-wood with a large folding bed and all the latest conveniences. The main saloon, which will be used as a dining-room, is handsomely furnished in oak with an old gold carpet and upholstery of rich terra cotta silk plush. A fine parlor organ and a writing desk are built in at one end. The forward end of the car is occupied by the kitchen, which is furnished in walnut and contains every convenience which the heart of the most accomplished *chef* could desire.

The lighting of the entire train is done by electricity, and the equipment put in for this trip is novel, so far as known, to this country, although a similar equipment has been placed in trains in Europe.

The sketch in connection is reproduced from one designed to show the various circuits, though not the relative positions of the cells, switches and wires. The sketch shows but two cars, the first and second, the arrangement in the third car being similar to that in the second.

In the forward end of the composite car is a Western Electric constant current series dynamo, commercially rated as a two-light machine. It is run by a Payne upright engine, which takes steam from an upright boiler of the same make. Under each car there is a storage battery of 32 cells of the "23 C" style, of the Electrical Accumulator company's make. The charging wires from the dynamo to the storage batteries are run over the roofs of the cars. The wires are in the form of a double cable and connection from one car to another is made through the medium of a double spring socket and hooks.

In the "P.P.C." and "Velasco" there are twenty-six sixteen candle power Edison lamps, and in the "Alafretta" there are seventeen lamps. Edison fuse boxes are used. The switches are so arranged that the operator can charge any one of the batteries, and the switches controllable by the porter, are so arranged that the lights in the body of the cars can be turned on or off without disturbing those in the vestibules of the cars.

An extra battery fully charged, is carried in the composite car to meet the emergency of any one of the others giving out. At the nominal rate of discharge, the average capacity of each battery is figured at 165 ampère hours, and it is believed that the dynamo will not have to run more than fifteen hours a day to charge all the batteries.

On the vestibule train referred to heretofore, storage batteries are carried from one end of the trip between Chicago and New York to the other, and on arrival at either city the discharged batteries are exchanged for freshly charged batteries. Inasmuch as the discharged batteries are recharged while the train is on the trip the only loss of time that occurs is in exchanging discharged for recharged batteries at either end of the route. As it is impossible to hold the train at either the Chicago or New York depot for any length of time, for the reason that both stations are crowded with trains, any great consumption of time would not be permissible and therefore the laborers who do the work of exchanging have been drilled to do it in the shortest possible space of time. This work is now done in Chicago in about eleven minutes. If the presidential train was traveling only between cities where railroad stations were especially equipped to provide storage batteries at a few minutes notice, there would be no need of the dynamo, engine and boiler, but on so extended a tour as the party will make, unless special provisions were made for charging the batteries, the party after exhausting their supply would either have to go without light or return to oil or wax candles. Consequently the dynamo and steam power were provided for the trip, and with these accessories the tour can be prolonged indefinitely, if desired.

Johnson, Holland & Co., representatives of the Elec rical Accumulator company, had charge of the electric equipment of the train.

The regular meeting of the Chicago Electric club will be held next Monday evening, October 3rd, at 8 o'clock at the rooms 223 Dearborn street.

E. R. Warner will read a paper on "automatic current regulation."

Electric Street Cars, With Special Reference to Methods of Gearing.[1]

BY A. RECKENZAUN C. E.

PART I.

Scarcely nine months have passed since your esteemed president, T. C. Martin, presented a paper on "electric street cars" to the American Institute of Electrical Engineers. I have read this excellent paper with interest, and I have learned a great deal from it, as also from the discussion which followed. Mr. Martin compiled some very important statistics regarding the number of horse cars in actual use in the United States, and he computed them to number 25,000, for the propulsion of which no less than 120,000 horses are requisite.

These figures filled me with wonderment and surprise, and when I read further on, that over 20,000 of these noble animals are rendered useless every year with overwork in street railway service, I felt it to be the duty of every engineer, electrical or mechanical, to assist with every means in his power in the emancipation of the horse from such cruel service. The percentage of loss given in the paper referred to agrees closely with our European experience. We know that the natural life of a street car horse is reduced to about four years, although it never works more than four hours a day. It seems barbarous, therefore, to employ animals for such purposes; yet until recently no economical substitute could be found. Steam, compressed air, gas and spring motors have been tried and found inefficient. Improvements may be made in one or more of these, but at the present moment the field of enterprise is entirely open to the cable and to electricity. There are over eighty miles of cable roads in operation in the United States, more than half of which have been laid down within the last five years, and there are indications that further and rapid progress will be made with this mode of traction, particularly in hilly districts, where it is impossible to apply self-propelled cars, owing to the want of cohesion between the wheels and rails when the angle of repose is approached.

On ordinary streets with gradients of not more than five per cent., electric traction will doubtless be more economical and far more convenient than cables, for well-known reasons. Not only is the first cost of construction far cheaper than the cable and its conduit, but the efficiency of the electric system is much greater.

It is admitted that on cable tramways some 70 or 80 per cent. of the total available power is consumed in dragging the cable itself, leaving a maximum of 30 per cent. for moving the cars, whereas with electric transmission over 50 per cent. can be utilized, as will be seen by the following figures, which I have obtained from ex-

[1] Read before the American Institute of Electrical Engineers at New York, September 20th, 1887.

periments on the electric railway at Frankfort in Germany. This line is worked by the overhead conductor system. Its total length is four and one-tenth miles, double track and groved rails. The entire circuit of the conductor is eight and one-fourth miles long, and its electrical resistance was calculated to be 1.6 ohms.

EFFICIENCY AND WORKING COSTS.

During the experiments referred to, two cars were propelled at a speed of seven and a half miles an hour; one of these cars had an electric motor, and the other was an ordinary car attached to the first, and the entire weight was ascertained to be 8.35 tons, including passengers. Electrical measurements were taken from the dynamo at the power station simultaneously with those on the car. The rails were in their usual dirty condition. When running on the level road the energy used on the cars was 3.87 horsepower, and on the generating dynamo 6.47, giving an efficiency of 59 82 per cent.; when traveling up a grade of 1 in 45, the motor gave eight horsepower and the dynamo 13.5, which again corresponds to 59 per cent. of the available electric energy. These measurements do not include the losses in the dynamo and motor, but it must be remembered that only two cars were on the road, while the capacity of the plant at the central station was sufficient for fourteen cars. With twelve cars running under the ordinary circumstances of traffic, the steam engines were indicated, and this showed a maximum of 164 horsepower, consuming two and three-fourths tons of coal per day of fifteen hours, or two and one-half pounds per indicated horsepower per hour. Reduced to car miles, the weight of coal came to 7.5 pounds, which, at three dollars a ton, would cost one cent per mile run.

The Frankfort Electric railway has carried over 3,000,000 passengers since its opening in April, 1884. The working expenses in the year 1886 amounted to $24,904, including the following items:

Salaries of directors, superintendent, engineers, electricians, conductors, drivers, firemen and laborers	$13,615
Repairs of roadway, rails, cars, machinery and buildings	5,088
Fuel (coal and kindling wood)	3,955
Oil and waste	831
Lighting and heating of buildings, lighting of cars and streets	1,415
	$24,904

The rolling stock consisted of fourteen cars, all of which were used on Sundays and holidays, but only eight cars were usually running on week days. If we take an average of ten cars, then the entire expenses would amount to $6.82 per car per day, but not more than one third of this, or $2.27, can be reckoned for the item of traction, which should only include wages of engineers, electricians, firemen, cost of coals, oil, and repairs to machinery.

There are about a dozen electric railways in successful operation in Europe, some more extensive than the one I have just described, some smaller; but this one in Frankfort is worked at a greater expense than any of the others I know of; it has been in continuous use for nearly three and a half years, and I thought that giving you detailed and exact figures of *one* line, it would serve your purpose better than by trying to crowd a few generalities of all our electric tramways into the small compass of a short paper. You can take this as a safe standard of comparison with other systems of street car traction.

It will be observed, with justice, that the dynamos and motors of the Frankfort line, which was projected more than four years ago, do not yield as high an efficiency as more recent machines. This would leave us another margin. It is well to have a margin in all our estimates, for there is nothing that retards the progress of a novel enterprise more than exaggeration of facts, or statements which cannot be fully borne out in practice.

Some people are apt to base their calculations and estimates upon theoretical conditions. We should never assume perfection in the case of street railway tracks, but on the contrary we ought to adapt ourselves to the roughest of the rough in order to succeed.

(*To be Continued.*)

THE CONVENTION

OF

THE NATIONAL TELEPHONE EXCHANGE ASSOCIATION.

The ninth annual meeting of the National Telephone Exchange association was convened in one of the parlors of the Monongahela house, Pittsburgh, Penn, Monday morning, September 26th, at 11 o'clock.

The following members and guests were in attendance:

C. N. Fay, president of the association, Chicago.
Gen. C. H. Barney, secretary, New York.
R. W. Pope, New York.
F. W. Harrington, New York.
J. K Dunbar, Austin, Texas.
C. E. Stump, New York.
Thos. D. Lockwood, New York.
Geo. L. Phillips, Chicago.
C. H. Maclilie, Chicago.
E. V. Cherry, Cincinnati.
Sam. M. Bryan, Washington, D. C.
J. W. Bennett, Lowell, Mass.
Chas. J. Glidden, Lowell, Mass.
J. W. Pickering, Lowell, Mass.
H. D. Storke, New York.
Sam. Ivers, New Bedford, Mass.
Edw. J. Hall, jr. New York.
J. H. Blasdell, New York.
H. B. Thayer, New York.
W. D. Sargent, Brooklyn, N. Y.
W. J. Denver, Boston, Mass.
A. S. Hibbard, New York.
C. A. Seeley, New York.
T. B. Doolittle, Boston, Mass.
J. W. Ebert, Kansas City, Mo.
J. P. McKinstry, Cleveland, O.
F. W. Harrington, New York.
W. N. Easterbrook, Elmira, N. Y.
G. F. Durant, St. Louis, Mo.
Chas. W. McDaniel, Kansas City, Mo.
Wm. A. Hovey, Boston, Mass.
E. J. Hall, Buffalo, N. Y.
A. B. Uline, Buffalo, N. Y.
H. N. Gifford, Louisville, Ky.
Geo. L. Beetle, New York.
E. B. Field, Denver, Col.
C. E. Scribner, Chicago.
Chas. A. Brown, Chicago.
W. A. Kreidler, Chicago.
Geo. T. Manson, New York.
H. D. Stanley, Bridgeport, Conn.
A. V. Garratt, Boston, Mass.
R. F. Ross, Boston, Mass.
Clark B. Hotchkiss, New York.
P. C. Ackerman, New York.
G. L. Wiley, New York.
R. W. Ryan, New York.
T. A. Forbes, Detroit, Mich.
A. C. White, Providence, R. I.
F. E. Degenhardt, Chicago.
J. P. McQuaide, New York.
J. W. Marsh, Pittsburgh, Penn.
S. M. Plush, Philadelphia.
J. B. Ker, Harrisburg.
D. B. Parker.
E. V. Cavell, Chicago.
J. M. Jackson, Chicago.
W. R. Patterson, Chicago.
S. A. Duncan, Pittsburgh.
F. G. Beach, Chicago.
H. C. Davis, New York.
Mr. Garden, New York.
C. C. Gould, Batavia, N. Y.
Walton Smith, Batavia, N. Y.
P. W. Scribner, Tonawanda, Pa.
J. S. Thompson, Tonawanda, Pa.
Henry Metzgar, Pittsburgh.

MONDAY MORNING'S SESSION.

The convention was called to order by President C. N. Fay of Chicago.

The secretary called the roll of members, and the Central Union Telephone company which, two years ago resigned, was re-elected a member of the association.

SECRETARY BARNEY'S REPORT:

I have the honor respectfully to submit my report as secretary of this association for the year ending August 31, 1887.

The changes in membership since my last report have been as follows: At the beginning of the association year, we had 34 active members and 32 honorary members. Of the former, all remain on the roll, although the resignation of two of them, viz.: the Great Southern Telephone & Telegraph company of New Orleans, La., and the Cumberland Telephone & Telegraph company, of Nashville, Tenn,, are in the hands of the secretary, awaiting the action of the association. At the annual meeting, a year ago, in St. Louis, one new active member was admitted, the Rocky Mountain Bell Telephone company of Salt Lake City.

Of the honorary members, three, viz.: the Standard Electrical works, of Cincinnati, the Western Electric company, of Chicago, and the J, A. Roebling's Son's company of New York, have been transferred to the new class of "associate" members, established at the last meeting. Two new associate members have been elected, viz.: Clark B. Hotchkiss, of New York, and the American Electrical works, of Providence, R. I. We close the year with 35 active, 5 associate, and 29 honorary members,

The office of the secretary remained at 234 Broadway, New York, until May 1st, of the present year, when the parties of whom desk room had been hired removed to other quarters, and the office of the Association was located at 32 Nassau street, where it has since remained.

The publication of the "News-Letter" has been continued throughout the year, and seems to be appreciated, judging from the fact that if the copies mailed to any member, fail from any cause to reach him, he, usually, very promptly writes stating the fact, and asking that other copies be forwarded. Naturally, he would not do this, unless he found the information contained in these semi-monthly bulletins to be of value.

It seems proper at this point to again remind members of the association how much they can add to the value and interest of the "News-Letter" by promptly communicating to the secretary, any and all matters of news from their respective localities. Coming from such sources, the news would posses the stamp of authenticity, which can not always be said of newspaper information. It was at one time contemplated to publish a roster or directory of the telephone field in the United States, and nearly all the material for such a work was collected by the secretary. But, in the opinion of some of our officers, the association could not properly pay for its printing and the matter was dropped. As several members have signified their desire for such a directory, it is possible that a sufficient amount of advertising might be secured to pay for the expense of publishing it.

The report of the treasurer, which is herewith submitted, is a gratifying one, inasmuch as it shows the association to be solvent, and that its expenses for the past year have been kept within its income.

The following is a summary:

Balance on hand last report	$38.35
Receipts of the year	2,024.77
Total	$2,063.12
Expenditures of the year	2,025.79
Balance on hand	$37.33

The sources from which our receipts were derived were as follows:

Annual dues	$1,900 10
Initiation fees	55.00
Sales of extra copies of proceedings	69.67
Total	$2 024.77

The distribution of the expenditure was as follows:

Salary of secretary	$1 200.00
Rent of office	140.00
Printing proceedings St. Louis meeting	270 00
Other printing, "News-Letter," circulars and blanks	151.10
Office expenses, stationery, postage, telegrams and subscriptions to newspapers	108.54
Stenographer at St. Louis meeting	87.80
Other expenses at St. Louis meeting	68.35
Total	$2,025.79

The assets of the association at the present date are as follows:

Cash in hands of treasurer	$37.33
Due from Cumberland Telephone & Telegraph Co. (dues for 1884, 1885, 1886 and 1887 and assessment for 1886)	120.00
Due from Great Southern Telephone & Telegraph Co. (dues for 1887)	50.00
Total	$207.33

The association owns about $10 worth of office furniture and a considerable quantity of the printed proceedings of previous meetings from the first to the eighth. On these last no definite value can be placed, although some of them are sold from time to time.

It is pleasant to state that the association has no liabilities, every claim against it having been paid in full to date.

It is reasonable to expect that next year's income will, in like manner, as the last, suffice for the year's expenses.

THE TREASUER'S REPORT.

The treasurer presented a detailed report, the substance of which was stated in the report of the secretary.

Both reports were, on motion, approved and ordered to be placed on file.

A verbal amendment was made to the constitution—"October" being substituted for "July" in line 2 of Article VII., in order to conform to the amendment made to Article XIV. at the St. Louis meeting, fixing the time when annual dues shall be payable.

THE PRESIDENT: Now, gentlemen, the hour has arrived for your president, as for every other one acting as the instrument of cruel destiny, to set in motion the machinery which shall shortly cut off his honorable and, in his opinion, most useful official activities. He must leave his conspicuous position and resume his seat in your numerous but insignificant midst. [Laughter.] He no longer can occupy this throne, from which he can say with Cicero that he sees the eyes of all of you concentrated upon him. He cannot longer look upon you with satisfaction—on you who remind of him of Euclid's definition of a circle—a curved line, all the points of which are equally distant from a point within called the center. No longer will some honored representative of illustrated journalism beg his photograph in order to show his constituents next morning "how like a fawning publican he looks," and thus amplify Shakespeare's words, that one touch of art—as well as nature—makes the whole world akin. He might be pardoned on such an occasion if he grasped his last opportunity and seized the one remaining hair on the forelock of Time, tied the old fellow's wings, tipped over his hour-glass, so that its sands should not run against him, and proceeded to swing his scythe so mightily that nothing should remain on the harvest field of rhetoric but endless windrows of imagination and toppling sheaves of eloquence. [Applause.] But on this occasion, impelled by modesty, he will simply say a few last loving words. His expectations of a year ago have not been disappointed. The business of the year has been larger in volume, I think, than certainly of any recent years in the history of the business.

Throughout the country a steady progress has been made in the actual art of telephony. Progress has been made in the directions of service, the permanent construction and maintenance of exchanges, the improvement of switching apparatus, and, I think, in the general harmony of relations with the public. It is to be hoped that the future will smile upon us as has the past. It is to be hoped that this association will go on, as heretofore, an instrument of usefulness among us. Its membership has reached in number perhaps its lowest point. The tendency to consolidation of the small exchanges into great corporations, co extensive with the land, has apparently ceased for a time, and the forty companies, or some such number, which now occupy the entire telephone field, and which constitute the membership of this organization, will probably not greatly diminish. I think I can say that the association is established, therefore, on a permanent basis, and that its members will, as heretofore—for I see many who have been, as I have, at every meeting of the association since its first at Niagara—continue to come here year after year, and contribute to our information, our progress and our enjoyment. I hope that the officers now to be elected will do their share in bringing about this happy result, and most of all the president, whom it is our duty now to ballot for. I do not doubt that your selection will be happy, and that he will far improve upon all his predecessors. I thank you for the honor you have done me twice and for the courtesy with which you have always treated me in the chair, and I now announce that we will ballot for the next president. May he suit the association perhaps with that identical *t* which is the difference between an *ex*-president and a *next* president.

The following officers were then elected, the secretary being authorized to cast the ballot of the association in each case:

OFFICERS FOR 1887—1888.

President, Henry Metzger, Pittsburgh, Pa.

Vice-president, Wm. D. Sargent, Brooklyn, N. Y.

Treasurer, H. L. Storke.

Member of Advisory Committee in place of W. A. Jackson, of Detroit, whose term of office had expired, E. J. Hall, jr., New York.

Members of Executive Committee, R. M. Bailey, Williamsport, Pa.; George M. Stone, Cincinnati; J. W. Bennett, Lowell, Mass.; S. M. Bryan, Washington, D. C.

Mr. Tyler proposed the following resolution: "The National Telephone Exchange Association at its ninth annual convention desires to express its sense of the misfortune which has befallen the telephone fraternity in the death of R. S. Boyd. Mr. Boyd by his sweet and genial temper, his hearty good nature, and his refined and attractive manners endeared himself to us all in the performance of the delicate task in which he put his tact and skill, his industry and unquestioned integrity at the service of his employers. In his death we deplore the loss of an honored and helpful member of this association and of a cherished personal friend, and as a token of the esteem in which his memory is held, the association orders that this minute be spread in full upon its records and printed in its published proceedings."

Remarks eulogistic of Mr. Boyd were made by Mr. Tyler, Mr. Metzger, Mr. Eastabrook, Mr. Hovey, and Mr. Storke, after which the resolution was unanimously adopted by a rising vote and on motion of Mr. Hovey the secretary was instructed to transmit a copy of the resolution to the widow of the deceased.

President Metzger made a few appropriate remarks welcoming the convention to Pittsburgh and expresed the hope that the visit would prove one of pleasure and of kindly recollection to the members.

C. N. Fay then read a paper entitled "Telephone Subscribers as Knights of Labor."

On motion of Mr. Eastabrook the paper was accepted and ordered placed on file.

The convention adjourned until half past two o'clock.

MONDAY AFTERNOON'S SESSION.

The convention was called to order at 2:30 p. m.

THE PRESIDENT: Mr. Phillips has received, since dinner, the following dispatch from J. E. Hudson: "Court this morning filed its opinion in the case of the United States against this company in this circuit, and our demurrer sustained; government bill dismissed."

This announcement was received with applause, and on motion of Mr. Bennett, the president and secretary were instructed to send a telegram to Mr. Hudson, congratulating the American Bell Telephone company "on their success in defeating the government Pan-Electric."

E. J. Hall, jr., of New York read the following paper entitled

NOTES ON LONG-DISTANCE TELEPHONE WORK:

To talk between points hundreds or thousands of miles apart as though standing face to face is a feat, the accomplishment of which, may well call for our best efforts. Apart from all commercial considerations it presents the fascinations of an unsolved problem. No sooner had the telephone exchange been an established fact than inventors and "promoters" began to suggest all sorts of visionary schemes for long-distance telephone work.

Of the early experiments, none were more successful than the trials between New York and Chicago, speech being transmitted between those points by a number of persons with fair results. These trials showed that, under certain conditions, it was possible to talk for a distance of over a thousand miles. We all know, however, that commercial business could not be carried on under these conditions, as all successfull tests were made when the wires were free from outside disturbances. As they were clear only on Sundays, and even then only when there were no storms, or heavy earth currents, the effect of early experiments was rather to discourage work in this direction.

In Canada and in the Western states some long lines have been operated with success, the distances covered being far in excess of any practical working lines in the Eastern states. The reasons for this have often been discussed in our conventions, and I will not go into them now; it is enough to say, that giving all due credit for what has been accomplished, no large business can ever be worked up on the basis of using grounded circuits, owing to the inevitable cross talk between parallel wires. The first really practical success in talking over long distances was the copper metallic circuit constructed between New York and Boston by T. B. Doolittle for the American Bell Telephone company in 1883. The distance was about 300 miles, and I call it the first practical success because it was the first circuit that worked at all times regardless of outside electrical disturbances.

Early in 1885 I was appointed by that company to take charge of the development of this branch of telephone service, and the American Telephone & Telegraph company was organized to carry on the work. At the outset it was decided that only copper wires in metallic circuits would be used, and that nothing should be spared to make the plant in every respect as perfect as we knew how to build. A builder whose work is known to you all—W. H. Fairbank—was appointed general superintendent of construction, and the first line was constructed between New York and Philadelphia. The specifications for this line required the use of poles not less than seven inches in diameter at the top and from forty-five feet upward in length; to be set six feet in the ground on straight lines and seven feet on corners or sharp curves. The poles had gains for seven tenpin arms and three arms were at once put on, carrying twenty-four copper wires. In addition to the copper wires, one number 8 iron wire was strung on a top pin to strengthen the line—especially during construction. The utmost pains were taken in guying and bracing, and the good results of this care in building have been fully demonstrated by the nominal expense of maintaining the line since it was finished.

There are nearly three miles of submarine cable in this line, and all crossings are made with four seven conductor kerite cables. In three of these cables the conductors are each composed of three number 18½ B. W. G. copper wires twisted together and insulated to $\frac{8}{32}$ of an inch, and the cables are armored with 18 number 4 galvanized iron wires. The fourth cable has conductors of three number 16 wires twisted together and insulated to 10½-32 of an inch, and is armored with 18 number 2 galvanized iron wires. The cable houses are large, dry and well lighted, and special care was taken to guard against lightning and bad connections and leaks in the terminals. All underground and aerial cables are of large conductors, heavily insulated, and the general result has been a line which for nearly two years has worked with uninterrupted success Wind, sleet, lightning and electrical storms have, so far, passed over it without causing more than the most trifling damage, and we have secured one of the most essential elements of any factor in commercial business—reliable service.

That this line would talk well no one questioned, as the distance—about one hundred miles—is far within the limit which previous experiments had shown to be entirely practicable. I will say here that we have not yet reached the limit of distance, but having worked over four hundred miles we know it exceeds that. It is probable that the progress of electrical development will keep the possible limit up to the distance over which it will be commercially profitable to supply this service.

Since the completion of the Philadelphia line we have started lines of similar character between New York and Boston—250 miles—and New York and Albany, 160 miles. The Boston line will be ready for service in a couple of months and the Albany line by the end of this year.

Having completed our first line we were at last in a position, not to commence business unfortunately, but to work out patiently and thoroughly the problem of making these lines serviceable. Many of you will remember that at our Providence meeting, two years ago, we discussed the question as to whether there would be any serious cross talk between metallic circuits when we had a large number of them working on the same line of poles. Opinions then varied, but the Philadelphia line showed at once that the interference between metallic circuits was practically about as bad as between grounded circuits. We determined not to offer an imperfect service to the public, and months of hard work resulted in perfecting a simple and practical method of absolutely removing all trouble from this cause, Meantime, the matter of providing suitable apparatus and methods for working metallic circuits quickly and reliably with each other and with grounded circuits at the terminal stations, was receiving constant attention, and we now are able to do this work satisfactorily although this part of our service will always be one in which we may expect continued improvement.

As an illustration of the difficulties encountered: The repeating coil, which gave excellent results when used between New York and Philadelphia, was a complete failure when used between New York and New Haven, and a long course of investigation and experiment was necessary before we discovered the cause and provided a remedy. We have completely reversed the old idea that "anything is good enough for a telephone line;" now I would say "nothing is good enough," but a friend suggests that, strictly construed, my statement makes the matter worse. At any rate the best is not too good, and I am confident that the future experience of us all will convince us, if we still doubt, that the best is emphatically the cheapest in the long run.

The telephone business has now been established long enough to bring us fully into the reconstruction period. The haste of early construction is over and the problems of underground construction in our larger cities, the general use of cables in all exchanges, the necessity of providing improved switching facilities for the masses of wires which center in our large offices, and the complicated work of providing quick and certain means of communication between our scattered exchanges, are matters which call for the expenditure of lots of brain force and money before the "second construction" gives us a perfected system.

When we look over the history of the development of the telegraph and see the slow and painful progress made by the pioneers of that enterprise, it may well be a matter of surprise and congratulation that the telephone has so quickly found a profitable place in the business world To a great extent that place had been prepared by the changes in business methods wrought by the railroad and telegraph. The use of local private telegraph lines—and especially the district telegraph service—was of especial value to us in preparing the way, by educating people in using electrical appliances for securing quick local communication.

Undoubtedly the use of the telephone has made far easier the work of introducing the electric light. This process of education is going on at a rapid rate, and the use of private wires between distant cities, which is now so common as to be almost a necessity in certain lines of business, and the extension of our "extra-territorial" telephone lines, is preparing the way for the long-distance telephone.

I am often asked the question, "How can you expect people to use the telephone on your long lines with rates five or ten times as high as the telegraph charges." The answer is simply this: The telephone has a field of usefulness entirely separate and distinct from that occupied by the telegraph. Of course no one will pay a dollar for a telephone message when he can accomplish the same result by sending a telegram for ten cents; nor will he pay ten cents for sending a telegram when he can accomplish the same result by sending a postal card for one cent. If the long distance telephone competes with anything it is with the railroad, and it does that in the same way and about to the same extent as the local telephones compete with livery stables and street cars. As a matter of fact the service offered by the telephone is something which is entirely new and when people learn its uses its place will be just as securely fixed, as a most important factor in the transaction of business between distant points, as it is now in local service, and the railroads and the telegraph companies will not suffer any more than the livery stables and street cars do not from the telephone exchange. When persons ship freight for which they are in no hurry they send it by a sailing vessel or by rail as ordinary freight; when time is of some importance it goes by steamer or by a fast freight line; when goods are perishable or time is important, shippers send by express or by special messenger. So when in communications time is not important, people write letters; when greater haste is necessary they send telegrams, but when time presses and there is urgent need for haste, they telephone. When the nature of the business requires personal communication, question and answer, the railroad or the telephone line must be used, and this is our field; quick communication with instantaneous replies and prolonged personal interviews. I might give scores of illustrations, but two will suffice: A New York lawyer recently called up by telephone a lawyer in a city nearly a hundred miles away, engaged him for an important case, dictated a lot of legal papers and inside of an hour was able to file attachments securing for his clients their interest in a large amount of property which would otherwise have been lost. This illustrates one class of service; the other is the case of the Pennsylvania railroad which has ample telegraphic facilities between New York and Philadelphia, but in addition, leases a private telephone circuit, so that the officers of the road can, without the intervention of operators and the delay of writing messages, carry on conversation between the two cities.

The contracts for service which we are daily making, and the emphatic commendation of business men who are using our lines, prove beyond question that the long-distance telephone is wanted, and that good service will be paid for at rates which will make it profitable to supply the demand. It is just as certain that there is no demand for, and no profit in attempting to furnish, poor service, either in trunk lines or exchanges. Just what constitutes "poor service" is a question upon which we may all agree. I think Mr. Jacques defined good commercial service well, in a discussion of this question recently, when he said, in substance, that he considered a good commercial line to be one over which non-experts could converse about subjects with which they were not both familiar, without repetitions. Judged by this standard, how many exchange and toll lines would stand the test?

On motion, it was agreed that the paper should be printed as part of the proceedings of the convention.

MR DURANT: I would like to ask Mr. Hall to what extent the so-called long distance transmitter is used in supplying the customers with this long distance service.

MR. HALL: It is used altogether on our line.

MR. BAILEY: How many poles to the mile are used on the line between New York and Philadelphia?

MR. HALL: About 40 poles to the mile is the average.

MR. BAILEY: Is there any great trouble with sleet storms through that country?

MR. HALL: We have had two quite heavy sleet storms since the line was finished. The copper wire stood all right.

MR. GIFFORD: What changes are necessary, and are they very great in adapting grounded lines or ordinary exchange lines to connect with this metallic circuit?

MR. HALL: The connection between the metallic circuit and the ground line is made through a repeating coil.

MR. GIFFORD: Repeating coils can be attached to the switch board commonly in use—the multiple—and you can use the same switch board and appliances, and the necessary changes are easily made, are they?

MR. HALL: Very easily made, yes. When the re-repeating coil is at one end of the line, the service is very much better than when the repeating coil is used at both ends. The introduction of a second coil seems to bring in quite a serious loss. At the same time, between New York and Philadelphia, where we have good terminal lines and the instruments are in good order, there is no difficulty at all in carrying on between exchange subscribers in both cities a good business conversation. But if there is any trouble at all in the terminal line then there is difficulty. The repeating coil seems to reduce the efficiency so far that there is no margin to spare. I am speaking of using the ordinary Blake at both ends, connected with the ordinary switch board at both ends.

MR. FAY: Suppose it failed at one point—failed at New Haven, for instance?

MR. HALL: Well, the explanation of the failure of the repeating coil which worked on the Philadelphia line and did not work on the New Haven line, is this—I do not know whether it is absolutely correct or not, but it is a conclusion which we reached: The line between New York and Philadelphia is built largely through low, wet country. There is a great deal of marsh land and the line is much freer from earth currents and disturbance than the New Haven line which is built over a rocky, hilly country and which has either a greater number or greater intensity of earth currents, or else does not have sufficient ground to relieve the line. The effect of that was, when we put on a coil with a high static capacity, the earth currents of the metallic circuit were all carried into the grounded line, and by putting in a repeating coil with a small amount of static capacity the trouble was obviated.

MR. LOCKWOOD: I would like to corroborate or add my mite of opinion to what Mr. Hall has said with regard to the upsetting of the old notion that any kind of a line will do for a telephone. A good many of us can remember the time when a story used to be told in these meetings that steel wire of almost any degree of smallness would stand just as well for a telephone line and would be just as serviceable in the matter of transmission as the best line that could be built, and a great many steel lines of very small gauge were put and used. I am not disposed to deny that the use of small wire did enable the line fiend to get into a great many places, and I think for that reason very possibly suburban work was materially advanced. A little later, some of us will remember, the theory was broached that insulation was superfluous in telephony. One gentlemen went so far as to advocate putting up long lines, 30, 40 and 50 miles long, without any insulators whatsoever. A great many did not go so far as that, but they put up the porcelain knobs of which I may have a word or two to say in a special paper. Porcelain knobs are still sometimes used, and they have a function where they are protected from the weather and where the line wire is covered, but they are certainly not of any use where the line wire is bare and exposed to the weather. Instead of assuming that, as the telephone will work as well as it does under adverse conditions, over a bad line, over a leaky line, over a line with bad joints in it, the telephone will work over any kind of a circuit, we have reached the point where we must assume that the telephone current is a small thing at best. Again and again we have heard that the current generated by the telephone is not much more than the one-millionth part of the current of a Daniell cell, and we have got to start from that point and realize that we can not make its conditions of transmission too easy. Hereafter, when we put up a subscriber's line every one of us has got to understand that that line may be a possible link in a long line of communication between two or between three or four adjacent cities, instead of being only connected occasionally through an exchange switch board to another line of equal length or approximately equal length, we have got to regard it as one end of a very long line, perhaps two or three hundred miles long, which has a link of like character at the other end of it, and we must not forget that the two ends are the most important parts of the line of communication. It does not matter how good a line we have in the middle, how good a line we have in the 50 or 60 miles which extends between the two subscribers that are talking, if the ends are bad—if the work is bad. And so I think it may be emphasized, and it can not be emphasized too frequently, that the short exchange lines have got to be built in just the best way we know how; the line wire must be good; the insulators must be good; the joints must be made in the best way. It does not do to put glass insulators only as far as we think a man will go and look at them. I remember a line which was recently built for a gentleman of my acquaintance. He specified particularly just the kind of a line he wanted. The general manager of the telephone company unquestionably agreed with him that the conditions he named were highly necessary for the line and gave the necessary orders. The line was built and when the subscriber that it was built for came home and looked at it, he found that although he had specified glass insulators it was put up on porcelain insulators. He brought that fact to the general manager's notice. The general manager agreed with him, as would be expected, and said that the had given orders that the line should be built just as well as it could be built. But he again gave orders that the porcelain knobs should be taken down and that the line should be insulated with glass. The lineman went and insulated that line with glass just as far as he thought that subscriber walked back over his line, and left the knobs on the rest of the line. But we must give the best attention to the ends. I think that if we must have a bad link in the line of communication anywhere it is better to have it in the middle and have the ends perfect. Ground connections we must look after sharply. I think a ground connection should be inspected frequently. If you put a ground connection around a gas pipe or a water pipe, and the water man or the gas man goes to it, he does not ask us whether that is a ground wire. All he will do will be to twist it around and leave it. Very frequently he does not do anything to it. Therefore I think that is a point to be insisted on in exchanges, is the frequent inspection of ground wires.

E. J. HALL, JR.: A little incident occured last week that I think will prove interesting. Mr. Hibbard called for Boston over our new line, which is now completed as far as Springfield. About 175 miles from New York the line was connected through a repeating coil on a copper wire between Springfield and Boston, about 100 miles further, so that the line as made up was 175 miles of metallic circuit and 100 miles of ground wire, connected through a repeating coil. The 100 miles of ground circuit was very noisy. Mr. Hibbard was for that reason unable to make the man in Boston understand what he was saying, but he was able to understand clearly every word that the Boston man said. The Springfield man, who was on the grounded circuit, could not hear the Boston man talking to him, and Mr. Hibbard, in New York, talked to the Springfield man and told him what Boston was trying to say to him. The effect of the repeating coil was to screen out the noises of the ground circuit apparently, and while the direct current, which went into the metallic circuit from the Boston transmitter, was not very loud, it was perfectly clear and distinct, so that he heard without difficulty everything that was said in Boston He says that he could have carried on a long conversation, or could have taken down a newspaper article, or anything of that kind, from dictation. But the man who was 175 miles nearer to Boston and on the direct circuit could not hear Boston.

MR. LOCKWOOD: Mr. Gifford asked how their induction coils were made and how connected. A great many of us have had practice with those coils and know that the coil is simply an ordinary induction coil differently constructed—that is, while there are two wires, each one is alternately the primary and each one is alternately the secondary; it depends on which way the transmission is going. Each of the wires, of course, has two terminals, or screw posts, and the two terminals of one wire are connected with the two ends of the metallic circuit, while in the other wire, one screw post is connected with the line and the other with the ground terminal of the exchange line.

MR SEELY: Have you reference to the induction coil or repeating coil?

MR. LOCKWOOD: I had reference to that species of induction coil which we call a repeating coil.

MR. GIFFORD: We have all had more or less trouble with bad connection, and in the last few months I think I have had more trouble with bad connection in our Louisville exchange than I had before in eight years. I find that some solder joints are just as bad as some of those that are not soldered. I would like to make an inquiry in regard to those new fangled connectors that McIntire, I think, has a patent on. They are in Newark, N. J. Those connectors are two little tubes soldered together, and you run the wires in and then twist them. I am using them and they work very nicely. I have used them only a few months. My opinion is they are going to be better than any other connections we have ever had A good soldered connection is a good thing, but I find it is almost impossible to get a man who will go out and solder connections unless you go and stand over him with a club. If those other twisting connections will answer the purpose, we will probably get our lines built better by using them. I would like to know if any one has used those connections and what the experience has been with them.

MR. HALL: Those McIntire connections were designed originally for our long distance lines. Before we adopted them, we had a thorough test made at the mechanical department of the McIntyre joint, the Brittania joint soldered and the American twist joint soldered,—the joints all being made by good linemen. Probably they were better joints than would ordinarily be made in practice, particulary as to the solder connections. The McIntire joints showed that we had the full strength of the line wire in the joints. The other joints fell off from 15 to 25 per cent. I have forgotten now which was ahead, but the best showed a loss of at least 15 per cent. in the strength of the line wire; that is, the break was always at the joint and at a pull of 15 or 20 per cent. less than would break the wire itself. We have used the McIntire joints since that time exclusively and they have given us entire satisfaction. I apply those joints to both iron and copper wire.

MR. LOCKWOOD: I think there may be difficulty if they are applied to iron wire; that is, the conductivity may be much impaired within a few months on account of chemical action between the two metals.

MR. GIFFORD: The holes of the tube fit very snugly over the wire and it makes a very tight connection and it is better than anything we have used. I have not soldered joints on iron wire. I used iron tubes on the iron wire and copper tubes on the copper wire.

MR. SEELY: I think it would be advisable if all the connections that could be gotten into the switch board were of platinum. Steel plugs rust, brass plugs wear out very rapidly and platinum plugs can be made very cheaply and I think they would help the service very much.

MR. BAILEY: In the last year we have been fitting up a lot of bells with a small switch of our own manufacture in which we use platinum points and platinum plates. We have fitted up probably from two to three hundred bells and I have not found the first one to fail us yet. I think that if that was carried all the way through in switch-board connections and everywhere, it would save a vast deal of money in inspection and give a vast deal of comfort and satisfaction in service.

President Metzger expressed the hope that those who make apparatus for telephone exchanges would bear in mind the suggestions made by Mr. Seely and Mr. Bailey.

Secretary Barney presented the following report on

EXCHANGE STATISTICS.

Reports have been received from thirty-seven exchanges, representing 56,131 subscribers. These reports have been made from 22 companies; 7 have failed to report.

Following out the plan of last year's report, the results deduced from these reports will be presented in a series of comparative tables The first one includes the population, the number of subscribers, the increase since last year, and the present ratio of subscribers to inhabitants.

In 1886, Providence included in its report Pawtucket, Woonsocket, Bristol, Warren, Attleboro and North Attleboro, which are omitted this year; hence the apparent loss in subscribers.

Twenty-eight exchanges in the above list, reporting last year and this, had, in 1886, 39,925 subscribers. This year they report 43,496, a net gain of 3,571, or about 9 per cent.

New York made the greatest gain in numbers, 831, and this gain would have been still larger but for the fact that they stopped taking contracts several months ago, being unable to provide facilities for any more subscribers. Chicago shows a gain of 510, and Brooklyn of 500. The latter exchange shows the greatest percentage of increase, the number of subscribers in 1887 being nearly 18 per cent. greater than last year.

In the ratio of telephones to inhabitants, Grand Rapids, Mich., leads with one to every 37 of her people. Atlanta comes next with one to 43, which is even a better showing when it is considered that nearly half the population of that city are blacks, and of a class from which telephone subscribers are rarely recruited. Portland, Me., has 1 to every 46; Williamsport, Pa., 1 to every 49; Wilkesbarre, Pa., 1 to every 47; Providence, 1 to every 50, and Hartfort 1 to every 51 of the inhabitants. These telephone fields are evidently thoroughly developed. On the other hand, Philadelphia has only one telephone station to every 350 inhabitants, and Brooklyn, notwithstanding its rapid telephone growth, shows a ratio of only one in every 227.

TABLE NO. 1.—EXCHANGE SUBSCRIBERS.

	Population.	Subscribers, 1887.	Increase over 1886.	Present ratio, 1 to every	Subscribers, 1886.	Subscribers, 1885.	Subscribers, 1884.	Subscribers, 1883.	Subscribers, 1882.
Albany	90903	1258	----	72	----	----	----	----	----
Atlanta	37409	862	----	43	----	----	----	----	----
Baltimore (1885)	417220	2105	242	198	1863	1630	1450	1220	1017
Boston	362535	2130	283	170	1847	1696	----	----	----
Brooklyn (1887)	750000	3297	500	227	2797	2354	1846	1601	801
Buffalo	155000	1767	65	88	1702	1533	1420	1208	1047
Est. (1887)	800000								
Chicago	510373	4577	510	112	4067	3630	3246	2903	2596
Cincinnati	255189	2900	----	88	----	----	----	----	----
Denver (1887)	60000	840	61	71	779	751	723	680	620
Detroit (1887)	239265	2583	300	93	2285	1956	1700	1474	---
East Saginaw	43140	563	46	77	517	----	----	----	----
Grand Rapids	32000	873	114	37	758	----	----	----	---
Hartford	42551	824	----	51	----	----	----	----	----
Jersey City	152093	769	76	198	693	648	391	346	----
Louisville	155917	1661	225	94	1436	1271	----	----	----
Lowell	62000	638	51	97	587	800	----	----	----
Milwaukee (1887)	187802	1732	216	108	1516	1375	1113	960	----
Minneapolis (1885)	129200	1387	----	93	----	----	----	----	----
Newark (1885)	152988	732	----	209	----	----	----	----	----
New Haven	75000	1227	----	61	----	----	----	----	----
New Orleans	216140	1148	39	188	1109	1153	----	----	----
New York	1206299	6881	838	175	6043	5252	4808	4158	3451
Paterson	61811	642	2	96	640	651	551	473	----
Philadelphia	847170	2420	----	350	----	----	----	----	----
Pittsburgh	249379	2286	335	109	1951	1688	----	----	
Portland	33810	735	2	46	733	----	----	----	----
			Loss						
Providence*	120000	2417	751	50	3168	2802	1892	1745	----
			Loss						
Reading (Est. 1887)	59163	503	60	118	563	557	----	----	----
Richmond	63597	593	87	107	506	427	354	347	----
Saint Paul (1885)	111000	1025	----	108	----	----	----	----	----
Scranton	43850	617	44	71	573	----	----	----	----
Springfield	33310	565	30	59	535	----	----	----	----
Washington	159871	1362	90	117	1272	1138	872	----	----
Wilkesbarre	25000	527	64	47	463	----	----	----	----
Williamsport	23000	466	29	49	437	----	----	----	----
Wilmington	50000	500	60	100	440	----	----	----	----
Worcester (1885)	68389	718	73	95	645	777	----	----	----

Total number of subscribers—1887, 54,980; 1886, 39,925; increase, 1887, 4,382.

The next table exhibits the average number of daily connections. The business of thirty-seven offices is given, and that of twenty compared with last year.

Taking the twenty exchanges which reported last year and this, it will be seen that the daily connections have increased from 236,250 in 1886 to 314,790 the present year, an increase of 78,540, or little over 33 per cent. This is a greater proportionate increase than from 1885 to 1886, which was about 20 per cent.

Some of the larger cities show a remarkable increase; the most notable instance being New York, which has gained 838, or nearly 14 per cent. in subscribers, but has more than doubled the number of connections, increasing from 42,003 in 1886, to 84,750 in 1887. Chicago with a gain of 510, or 12 per cent. in subscribers, has increased its daily connections from 32,996 to 44,292, an increase of 34 per cent. On the contrary, Washington shows a falling off in the number of connections, from 6705 to 6219, although it has gained 90 subscribers during the year.

TABLE NO. 2.—DAILY CONNECTIONS.

EXCHANGE.	1887	1886	1885	1884	1883	1882	1881
Albany	6080	----	----	----	----	----	----
Atlanta	8517	----	----	----	----	----	----
Baltimore	19275	12500	10481	----	----	----	----
Boston	17345	12043	10385	----	----	----	----
Brooklyn	17508	14675	10809	5508	4741	----	----
Buffalo	7060	6485	5980	5480	5290	3842	2304
Chicago	44292	32996	31368	27101	22000	16044	16136
Cincinnati	45000	----	----	----	----	----	----
Denver	5230	4528	4167	5298	4170	3450	----
Detroit	33146	31723	20800	----	----	----	----
East Saginaw	7330	----	----	----	----	----	----
Grand Rapids	6800	----	----	----	----	----	----
Hartford	3692	----	----	----	----	----	----
Jersey City	4220	4000	----	----	----	----	----
Louisville	13200	12000	----	----	----	----	----
Lowell	2640	2265	----	----	----	----	----
Milwaukee	6548	6051	4461	----	----	----	----
Minneapolis	16000	----	----	----	----	----	----
Newark	2705	----	----	----	----	----	----
New Haven	6253	----	----	----	----	----	----
New Orleans	8002	7381	6791	----	----	----	----
New York	84750	42003	36153	25912	25891	19727	----
Paterson	2383	2800	----	----	----	----	----
Philadelphia	17098	----	----	----	----	----	----
Pittsburgh	18192	14435	11583	----	----	----	----
Portland	3354	----	----	----	----	----	----
Providence	12140	14423	12046	----	----	----	----
Reading	2239	2500	----	----	----	----	----
Richmond	7651	4307	4072	3013	----	----	----
St. Paul	9600	----	----	----	----	----	----
Scranton	3238	----	----	----	----	----	----
Springfield	2471	----	----	----	----	----	----
Washington	6219	6705	3939	2782	----	----	----
Wilkesbarre	3274	----	----	----	----	----	----
Williamsport	2600	----	----	----	----	----	----
Wilmington	1756	----	----	----	----	----	----
Worcester	2450	2450	----	----	----	----	----

Table No. 3 shows the average daily calls per subscriber, the daily use of the telephone by each being, of course, double the number of calls as given in the table.

Thirty-seven exchanges have reported, of which number twenty can be compared with last year. In 1886, Detroit

subscribers showed the greatest appreciation of the telephone, judging from the amount of use made of it, but this year they are surpassed by those of Cincinnati, which reports a daily average of 15 5 calls per subscriber. New York reports 12.3 calls daily from each station. It is evident that in all these exchanges there are the "busy wires" of which the poet writes, while on the other hand the taciturn inhabitants of Worcester, Mass., seem to converse with their neighbors only 3.4 times per day each, on an average.

Of the twenty exchanges reporting last year and this, twelve show an increase in the daily calls per subscriber, seven report a decrease, and one, Reading, Pa., is exactly the same as in 1886.

TABLE NO. 3.—CALLS PER SUBSCRIBER.

Exchange.	1887	1886	1885	1884
Albany	4.8			
Atlanta	9 8			
Baltimore	9.1	6 7	7.	6 8
Boston	8 1	6.5	6.	
Brooklyn	5.3	5.2	4.5	3.6
Buffalo	3.9	3.8	3.9	4 3
Chicago	9 6	8.1	8.6	3.4
Cincinnati	15.5			
Denver	6.2	5.8	6.	7.3
Detroit	12.8	13.8	10.6	
East Saginaw	13			
Grand Rapids	7 8			
Hartford	4 5			
Jersey City	5.4	5.7		
Louisville	7.9	8.3		
Lowell	4 1	3 8		
Milwaukee	3.7	3 9	3 2	
Minneapolis	11 5			
Newark	3.6			
New Haven	5..			
New Orleans	6.9	6 6	5.9	
New York	12.3	6.5	7.	5.1
Paterson	3.7	4.3		
Philadelphia	7.1			
Pittsburgh	8.1	7.3	6.8	
Portland	4.5			
Providence	5.	4 5	5.2	5.
Reading	4 4	4.4		
Richmond	12 9	8.5	9.5	8.8
Saint Paul	8.7			
Scranton	5.2			
Springfield	4.3			
Washington	4.5	5.2	3.5	
Wilkesbarre	6 2			
Williamsport	5 5			
Wilmington	9.5			
Worcester	3.4	3.7		

Table No. 4 refers to the number of connections lost or delayed from such causes as "busy," don't answer, and "in trouble." Thirty-seven exchanges have reported, twenty-five can be compared with 1886.

Milwaukee for the third year reports the heaviest number of lost connections, which is for this year, 15.2 per cent This, however, is much smaller than last year, when 34 per cent. was reported. New Haven, which did not report for two years past, shows the same percentage as Milwaukee. New York makes the remarkable claim that its "missed calls" only amount to 2658 per week, out of a total of 84,750 calls per day. Counting only six days per week, this percentage would be about one-half of one per cent, which seems almost incredible, but as some one has previously remarked, "figures won't lie," and these figures have been verified by personal inquiry at the office of the general superintendent.

TABLE NO. 4.—LOST OR DELAYED CONNECTIONS.

Exchange.	1887.		1886		1885.		1884.	
	No. Daily.	Per Cent	No. Daily.	Per Cent.	No. Daily.	Per Cent	No Daily.	Per Cent.
Albany	465	7.6						
Atlanta	200							
Baltimore	1224	6.3	900	7.2	900	9.	800	8.
Boston			1021	8.5	1618	5.		
Brooklyn	1363	7.8	817	5.6	506	5.	634	11.
Buffalo	527	7 5	421	6.5	446	7.	520	9.
Chicago	4326	9.8	3852	17.	2759	8.7	1355	5.
Cincinnati	500	1.[illegible]						
Denver	208	4.	186	4.1		6.		
Detroit	3209	9.7	2100	6.6	2120	10.		
East Saginaw	413	6.	263					
Grand Rapids	645	9.5	617					
Hartford	100	2 7						
Jersey City	269	6.4	200	5.				
Louisville	*	10.	*	10.				
Lowell	75	2.8	195	8.6				
Milwaukee	994	15.2	2052	34.	892	20.		
Minneapolis	1600	10.						
Newark	40	1.5						
New Haven	950	15.2						
New Orleans	450	5.6	600	8.1	26	6.		
New York	443	.5	2180	5.5	19.59	5.5	1789	8.
Paterson	216	9.1	1.5	4 5				
Philadelphia								
Pittsburgh	1735	9 4	1397	9 7	1085	10.		
Portland	263	7.8	238					
Providence								
Reading	268	12.0	150	6.				
Richmond								
St. Paul	900	10.						
Scranton	171	5 3	195					
Springfield	119	4.8	113					
Washington	576	9.3	738	11.	777	1.9	602	20.
Wilkesbarre	175	5.3	62					
Williamsport	250	9.6	158					
Wilmington	234	4 9						
Worcester	175	7.1	125	5.1				

*Estimated.

Table No. 5 gives the average number of connections made daily by each subscriber operator, from 8 a. m. to 6 p. m. Thirty-seven exchanges have reported these figures; twenty-six can be compared with last year.

By this table it appears that the operators at New Orleans do the most work and those at Newark, N. J., the least, the former averaging 1,073 connections daily, and the latter only 116. And notwithstanding the apparent fact that each young lady in the Newark exchange devotes five minutes to answering each call and making the necessary connection, the writer is able to aver, from personal knowledge, that the subscribers in that city are even yet not as happy as they would like to be.

Eighteen exchanges working on the multiple system, average 645 connections per day by each operator, while sixteen exchanges using straight boards average for each operator 350 daily connections.

In most exchanges the operators appear to be doing more work than last year, the reverse, however, being the case in Jersey City, Louisville, Paterson, Portland, Reading, Scranton, Wilkesbarre, Washington, Williamsport and Worchester.

TABLE NO. 5.—CONNECTIONS PER OPERATOR.

Exchange.	1887.	1886.	1885.	1884.	1883.	1882.
Albany m	429					
Atlanta m	746					
Baltimore m	788	595	390			
Boston m	788	514	375			
Brooklyn	384	367	277	177	132	
Buffalo	269	233	233	221	263	148
Chicago	328	300	290	271	202	161
Cincinnati m	522					
Denver	319	269	291	360	379	246
Detroit m	942	709	710			
East Saginaw m	732	643				
Grand Rapids m	469	372				
Hartford	310					
Jersey City	388	400				
Louisville m	612	633				
Lowell	440	324				
Minneapolis m	960					
Milwaukee m	345	335	281	203	269	
Newark	116					
New Haven	367					
New Orleans m	1073	1054	848			
New York	89[illegible]	200	255	145	120	114
Paterson	303	400				
Philadelphia m	465					
Pittsburgh	569	504	526			
Portland	305	327				
Providence	301	280	335			
Reading	334	355				
Richmond m	1028					
Saint Paul	304					
Scranton m	405	620				
Springfield	305	293				
Washington m	530	637	387			
Wilkesbarre m	444	469				
Williamsport m	325	401				
Wilmington	910					
Worcester	237	306				

TABLE NO. 6.—SUBSCRIBER'S WIRES PER OPERATOR.

Exchange.	1887	1886	1885	1884	1883
Albany	77				
Atlanta	85				
Baltimore	98	67	71	85	30
Boston	95	88	63		
Brooklyn	74	72	71	68	48
Buffalo	62	57	70	67	67
Chicago	34	37	33	34	31
Cincinnati	37				
Denver	52	48			
Detroit	76	71	70		
East Saginaw	38	55			
Grand Rapids	60	57			
Hartford	33				
Jersey City	58	64			
Louisville	71	70			
Lowell	42	37			
Milwaukee	76	71	91	64	46
Minneapolis	62				
Newark	46				
New Haven	73				
New Orleans	157	142	144		
New York	84	91		66	
Paterson	76	75			
Philadelphia	56				
Pittsburgh	65	62	65		
Portland	38	37			
Providence	28	35	35		
Reading	57	44			
Richmond	84	128	108	88	
Saint Paul	38				
Scranton	32	47			
Springfield	71	67			
Washington	80	79	126		
Wilkesbarre	34	53			
Williamsport	44	64			
Wilmington	90	92			
Worceester	34	34			

TABLE NO. 7.—COST OF CONNECTIONS.

Exchange.	Cost of One Connection.					
	1887	1886	1885	1884	1883	1882
Albany	.0026					
Atlanta	.0029					
Baltimore	.0013	.0045	.0025	.0040	0058	.0072
Boston		.0166	.0038			
Brooklyn	.0041	.0040	.0041	.0069	.0098	
Buffalo	.0053	.0057	.0064	.0060	.0047	.0072
Chicago	.0040	.0056	.0048	.0054	.0064	.0073
Cincinnati						
Denver	.0055	.0061				
Detroit	.0014	.0016	.0021			
East Saginaw	.0025	.0020				
Grand Rapids	.0024	.0052				
Hartford	.0041					
Jersey City	.0043	.0050				
Louisville	0026	.0033				
Lowell	.0062	.0063				
Milwaukee	.0032	.0035	.0046	.0113	.0055	
Minneapolis	.0016					
Newark	.0060					
New Haven	.0067					
New Orleans	.0018	.0011	.0015			
New York	.0078	.0083	.0066	.0066		
Paterson	.0056	.0050				
Philadelphia	.0037					
Pittsburgh	.0031	.0035	.0051			
Portland	.0071	.0078				
Providence						
Reading	0047	.0020				
Richmond	.0023					
Saint Paul	.0029					
Scranton	.0046	.0034				
Springfield	.0052	.0060				
Washington	.0037	.0031	.0051			
Wilkesbarre	.0045	.0028				
Williamsport	.0048	.0034				
Wilmington	.0020	.0026				
Worcester		.0073				

Eighteen multiple boards average 71 wires per operator; sixteen straight boards average 55 wires per operator. In both cases this is a reduction from last year's averages.

The cost of making connections in the several exchanges is shown by table No. 7, which contains statistics from thirty-three exchanges.

Four Pennsylvania exchanges, viz.: Reading, Scranton, Wilkesbarre and Williamsport, pay considerable more—from 25 to 100 per cent.—for connections than they reported last year. The following exchanges have slightly reduced their operating expenses, viz.: Baltimore, Chicago, Denver, Grand Rapids, Jersey City, Louisville, New York and Springfield. Brooklyn, Buffalo, Milwaukee and the rest of the list report almost identically the same cost as a year ago, showing the reliability of their figures, and indicating that they cannot bring their work down to a much finer point than it is at present.

TABLE NO. 8.—NUMBER OF TRUNK LINES.

Exchange.	1887.	1886.	1885.	1884.	1883.	1882.
Albany	24					
Atlanta						
Baltimore	18	17				
Boston	213	183	152			
Brooklyn	221	175	126	104	89	
Buffalo	57	57	45	37	26	21
Chicago	369	366	355	254	245	228
Cincinnati	260					
Denver						
Detroit	37	30	20			
East Saginaw	10	4				
Grand Rapids						
Hartford	16					
Jersey City	69	67				
Louisville	12	2				
Lowell	12	12				
Milwaukee						
Minneapolis	14					
Newark	23					
New Haven	20					
New Orleans						
New York	755	600	520	491	331	274
Paterson	21	26				
Philadelphia	60					
Pittsburgh	78	47	39			
Portland	5	6				
Providence	39	32	37	42	38	48
Reading	9	5				
Richmond		1				
Saint Paul	16					
Scranton	2	2				
Springfield	13	12				
Washington	4	5				
Wilkesbarre	7	7				
Williamsport	2	2				
Wilmington	6	6				
Worcester	12	8				

Table No. 8 gives the number of trunk lines, and as might be expected, shows that these lines are becoming more numerous each year.

Table No. 9 shows statistics regarding the daily use of trunk lines.

Seventeen exchanges reporting last year showed an average of 31 connections per day over each trunk line; twenty-six exchanges this year report a daily average of 39 connections. It will be noticed that in Detroit this average is greatly exceeded, that exchange making the remarkable claim of 155 daily connections over each trunk wire. These figures, however, have been verified and must be accepted as correct. The average also shows that the use of trunk lines is increasing year by year.

TABLE NO. 9.—TRUNK CONNECTIONS (DAILY CONNECTIONS PER TRUNK.)

Exchange.	1887.	1886.	1885.	1884.	1883	1882.	1881.
Albany	18						
Atlanta							
Baltimore	12	16					
Boston		27	24				
Brooklyn	22	25	33	22	28		
Buffalo	26	26	36	39	50	41	21
Chicago	75	61	56	38			
Cincinnati	38						
Denver							
Detroit	155	61	52				
East Saginaw							
Grand Rapids							
Hartford	9						
Jersey City	13	13					
Louisville	40	40					
Lowell							
Milwaukee							
Minneapolis	15						
Newark	16						
New Haven	27						
New Orleans							
New York	43	56	18	31	41	31	23
Paterson	10	10					
Philadelphia	36						
Pittsburgh	69	74	111				
Portland	8	11					
Providence							
Reading	76	4					
Richmond							
St. Paul	18						
Scranton							
Springfield	13	9					
Washington	16	18					
Wilkesbarre	25	30					
Williamsport	48	41					
Wilmington	22						
Worcester	80						

(*Continued on page 165.*)

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The Telephone Convention.

We devote a large amount of our space this week to a full report of the proceedings of the National Telephone Exchange association in annual convention at Pittsburgh, last Monday and Tuesday.

The report on "statistics" is not only a valuable one but very interesting, covering the whole ground as exhaustively as it does. Of course, an increase in the number of telephone exchanges is shown.

The papers presented by Mr. Sargent on the use of underground and aerial cables show the importance of this matter, and are full of information as to experiments that have been made.

Long distance telephony is a subject well treated by Mr. Hall.

Mr. Lockwood's paper on the progress of a decade in telephony and treating of the different eras, is one of great interest, and is one that will be appreciated years hence by students of the history of telephone construction perhaps more than it is at the present time.

THE electric motor only needs the opportunity to demonstrate its ability. One in Detroit, a couple of weeks ago, propelled a car containing forty-nine persons over a road at the rate of thirty-three miles an hour. The conditions were very favorable, however. The road-bed was unusually good, and there was but little traffic on the street to interfere with the experiment.

TWENTY-FOUR new railroads projected within six months in the little empire of Japan, involving the employment of $48,000,000 capital, reminds us of the experience of Illinois in 1836–8, when the state was gridironed with railroads, begun with borrowed foreign capital and abandoned before completion, leaving a legacy of debt, which required years to extinguish. If the Japs have a similar experience, they will bitterly regret the advent of railroads; and foreign capitalists may find themselves loaded with bad debts instead of profitable returns. It seems that Americans have kept out, and do not intend to get their fingers burned.

IN the account of the photographing of lightning given in our miscellaneous notes, the writer evidently makes the mistake of supposing that the camera was opened on the instant of the observance of the flash. A photograph of lightning under such circumstances would be impossible, as time in the lightning flash is practically annihilated, and the flash, had ceased at the moment of its appearance, only the effect on the retina of the eye remaining. It would therefore seem impossible that the photograph could have been obtained unless the plate was exposed previous to the observance of the flash; the darkness saving the sensitive plate from injury by the exposure, while the intense brilliancy of the flash would bring it out in marked contrast to any slight effect which the previous exposure may have produced.

The Chinese Government officials have lines of wire from Shanghai to the north and south well established and in good working order. Since 1873 there has been a cable between Hong Kong and Shanghai. Other lines are in working order, and there has never been any difficulty experienced by the Chinese in sending messages. It requires about 7,000 characters to conduct the everyday ordinary transactions in Chinese mercantile affairs. A book containing the characters, numbered from 1 to 7,000, has been printed by the telegraph authorities, and if a man wants to send a message he simply wires numbers representing the characters, and the receiver marks down the number at the end of the line. References is made to the book, and the characters are ascertained. The system has been working for the last thirteen years, and has given satisfaction to the Chinese.

THE Bell Telephone company have gained the victory in the celebrated suit brought by th- United States to annul their patents, the descis ion having been rendered in the United States circuit court in Boston by Judge Colt on the 26th ult. The validity of the patents is neither affirmed nor denied, but it is maintained that the government has no power to bring suit to cancel a patent issued by its authority, even when obtained by fraud, as alleged by the plaintiff in this case. It is also maintained that if it was the intention of congress to grant such power, a provision to that effect would have been incorporated in the patent laws, and that the absence of such provision must be accepted as evidence that such was not the intention.

The English provision for the cancellation of a patent by the government, which was cited to show the equity of the case, was stated to be a prerogative of the crown, and could not be considered as parallel to the present case.

The demurrer to the bill is sustained and the bill dismissed.

THE experiments of Nahrwoldt on the electrostatic discharge in air, and his theory deduced thereform that such discharge is solely due to particles of dust, will require to be verified by numerous crucial tests before it can be accepted. It is undoubtedly true that air charged with dust or smoke has greater conductivity and consequently less resistance than pure air; and that carbon from smoke-charged air, as well as dust, is electrically deposited in the manner described; as any person familiar with the use of a Holtz or a Töpler machine, in the smoky atmosphere of the city, soon finds out to his cost and annoyance; and it is probably true also that red-hot platinum throws off metallic particles, and that the higher resistance of pure air requires a higher degree of electric intensity to accomplish the same results. But nevertheless air is matter, and electricity is undoubtedly a universal property of matter, as much so as gravity, and all the experience of electricians for the last century, goes to show that the electric potential of air, like that of other matter, may be varied; that air in its purest state, sixty miles above the earth, in the auroral strata, is capable of being highly electrified; and that air molecules when electrified to the same potential are self-repellant, and are attracted by other air molecules at a different potential, the same as pith balls, gold leaf, tissue paper, or other light matter; and that air currents, or "electric wind" is the result. If air free from dust cannot be electrified statically, as Nahrwoldt states, then the air, one to three miles above the earth, in the region of the thunder clouds, is impure, and charged with dust and smoke, which is certainly contrary to the commonly accepted theory, or else air is not the medium of electric transmission from cloud to cloud.

If Nahrwoldt's theory is correct it overthrows the whole theory of atmospheric electricity; for either there is no such thing as air free from dust, or else no such thing as atmospheric electricity.

A British patent granted to R. Theiler of London describes a combination of telephone transmitter and receiver in such a manner that the two parts constitute a single instrument. The receiver and transmitter are enclosed in a box which consists of a small cylinder of metal or ebonite, closed at one end by the tympan of the transmitter, and at the other end by the tympan of the receiver. A screwed cover with a central aperture protects the receiving tympan. In the cover plate is inserted a cone or tube, which collects and concentrates the sound waves and serves as a handle to the instrument. When in use the opening of the cone is placed at the side of the speaker's mouth, and by this means inconvenience to the user and the objectionable condensation of moisture from his breath is avoided. The sound waves impinge only upon the outer curve of the cone, and a row of holes assists the clear transmission of sound waves along the cone. The receiver is constructed with a circular permanent magnet, one pole of which induces the iron cone inserted into the coil. The other pole induces the thin tympan. The transmitting part of the combination consists of a very thin tympan of steel firmly clamped between the edge of the box and the cover plate. To the center of this tympan a thin carbon disk is fastened, constituting one of the electrodes of a battery circuit. To the back of the tympan is fastened a disk of felt with a hole in its center, this hole being filled with hard carbon granules and closed by another thin disk to which a weight is fixed, constituting the other electrode.

Electrical Conductivity of Solid Salts under Great Pressure.

In *Abstracts* of foreign periodicals issued by the Institute of Civil Engineers appears a summary of a paper under the above title, by L. Graetz, in *Repertorium der Physik:* It is well known that the metallic salts in a solid state offer at low temperatures a high resistance to the electrical current, but begin to conduct at temperatures even far removed from their fusing point, and that the conductivity increases with further rise of temperature. As regards the electrical resistance of such salts when in solution, this may in some measure be identified with the resistance presented to the mechanical movement of the electrified molecules; and it should therefore follow that the salts in a molten condition would act as conductors of electricity; but the fact that they begin to conduct before this change of condition takes place points to some other connection between electrical conductivity and molecular motion, a conclusion arrived at by Kohlrausch from his experiments on iodide of silver, where no sudden change in its resistance was found at the passage of the solid to the molten state. If, however, electrical conductivity of such salts be assumed to follow on the same lines as thermal conductivity—that is, to be a function of the frequency of molecular collision—then subjection of the solid salt to pressure should alter its conductivity in the same direction as has been observed to follow increase of temperature. The author's experiments, which have evidently been made with the utmost care, most conclusively confirm his argument thus set forth. The screw press, by means of which an estimated pressure per square inch of about 700 atmospheres could be obtained, consisted essentially of a plunger working in a cylindrical hole, the sides of which being well lacquered, and a sheet of mica inserted to insure insulation between the two, so that the end of the plunger and bottom of the cylinder alone formed the electrodes, the distance between them being given by an index suitably affixed. The substances under examination required most careful desiccation, the completeness of which process was beautifully indicated by the behavior under the electrical test; thus, if the salt was not free from uncombined water, the resistance was found gradually to increase after the application of the pressure, owing to this water being slowly expelled to the surface, and on suddenly releasing the pressure a great decrease in resistance followed as a result of the water re-entering the capillary cavities; on the other hand, with the salt perfectly dried, the opposite result was noticed, owing to the less intimate contact between the electrode and the salts.

(Continued from page 163.)

the removal of these offices to the new gigantic multiple board in the new building on Cortlandt street.

Twenty-eight exchanges last year reported 21,159 direct and 4,830 circuit wires and thirty-seven exchanges reporting this year show 31,921 direct and 6,239 circuit wires. The tendency is evidently more and more toward direct wires, although the two three and four-party lines retain their popularity in New England, Worcester and Springfield both of which have gained in subscribers, having actually less direct wires than 1886

TABLE NO. 10.

Year.	Cord.	Plug.
1887	51627	12215
1886	34190	9235
1885	16985	15110
1884	38070	23118
1883	21432	12763
1882	16799	12755
1881	8893	11904

The proportion of "direct" and "circuit" wires in the different exchanges is shown in Table No. 11.

TABLE NO. 11.—DIRECT AND CIRCUIT WIRES.

Exchange.	1887		1886.		1885.	
	Direct	Circuit.	Direct	Circuit.	Direct	Circuit
Albany	1087	60			----	----
Atlanta	821	10	----	----	----	----
Baltimore	1078	372	1097	404	831	383
Brooklyn	2705	170	2157	195	1734	237
Buffalo	1258	174	1185	183	1102	165
Chicago	4577	----	4067	----	3630	----
Cincinnati	2220	299	----	----	----	----
Denver	740	44	717	9	715	10
Detroit	2060	231	1821	189	1605	156
East Saginaw	345	153	390	53	----	----
Grand Rapids	738	48	638	45	----	----
Hartford	176	193	----	----	----	----
Jersey City	442	143	385	131	350	127
Louisville	776	434	675	372	730	271
Lowell	82	173	32	227	52	221
Milwaukee	1311	129	1172	104	986	112
Minneapolis	579	281	----	----	----	----
Newark	697	2	----	----	----	----
New Haven	214	261	----	----	----	----
New Orleans	1034	47	995	73	975	84
New York	6842	3	604	6	5213	6
Paterson	433	99	441	92	459	94
Philadelphia	1897	182	----	----	----	----
Pittsburgh	1738	210	1457	205	1120	173
Portland	45	316	37	329	----	----
Providence	322	675	340	944	324	616
Richmond	580	6	490	9		----
Saint Paul	469	210	----	----	----	----
Scranton	84	168	69	164	----	----
Springfield	41	162	52	145	----	----
Washington	478	300	444	270	299	314
Wilkesbarre	128	73	119	91	----	----
Williamsport	114	152	105	151	----	----
Wilmington	433	17	372	33	----	----
Worcester	57	215	73	192	88	185

Table No. 12, salaries of operators, is gathered from a field of thirty-two exchanges, employing 1,150 operators, and shows the following results:

TABLE NO. 12.—SALARIES OF OPERATORS.

32 Exchanges—1,150 Operators,	Weekly salary.
Highest (including Chief Operator)	$23 75
Lowest	2 50
Average	6.02

As last year, New York pays the highest average salaries, viz., $13.13 per week, and Reading, Penn., the lowest, $3.87. The general average is $6.02 as against $6.61 last year.

The next table shows the wages paid to linemen and inspectors:

TABLE NO. 13.—SALARIES OF LINEMEN AND INSTRUMENT MEN.

34 Exchanges 248 Men.	Daily Pay of		
	Line Men.	Instrument Men.	Combination Men.
Highest	Philadelphia, $2.75	Louisville, $3.00	New York, $2.88
Lowest	1.50	Wilmington, .77	E. Saginaw, 1.15
Average	2.02	1.81	2.06

This table was made up from reports embracing 34 exchanges, employing 248 men. The highest average wages are again paid by New York, Louisville and Washington pay the lowest wages to linemen, and Wilmington, Del., the lowest to instrument men and combination men. In conclusion, it is gratifying that the report this year has been made fuller and more valuable for comparative purposes by the larger number of exchanges reporting, and it is to be hoped that next year may show even a greater improvement in this respect. The labor required to make out the reports asked for by the Secretary is very slight to each individual manager, and the consolidated statistical report, dry and uninteresting as it may be to listen to, is, when printed, useful for reference, and valuable for study at leisure in the future.

It was ordered that the report be embodied in the printed proceeding of the convention.

MR. SEELY: As the gentlemen of the convention seem to be amused at the small number of lost connections in New York, I would say that in New York, when a man calls for a connection, and the party he calls for is not in his office at the time, we make a note of it, and ring him up afterward. It may possibly be 20 minutes after the call that the connection is made. If the subscriber called for cannot be raised, the operator makes a ticket, which is filed on a hook. The tickets go to the chief operator, who is instructed to try to get those connections afterward. If they succeed in getting those connections during the whole day, of course they do not count them as lost connections.

MR. DURANT: The connection is not lost until the day is lost; it is good till sundown.

MR. LOCKWOOD: It is a realization of the old adage—nothing is lost if you know where it is.

Mr. Lockwood then read the following paper, entitled

TEN YEARS' PROGRESS IN PRACTICAL TELEPHONY.

The year 1887 marks a decade from the institution of the first experimental telephone exchange, and it seems an eminently proper time for a retrospective glance through the various and transitional conditions through which the telephone exchange system as a whole has passed on its way to the present period and degree of excellence.

Ante-Telephonic Exchange Systems.

It is fitting at this point that your attention should be called to the fact that the idea of electrical intercommunication is older than the electrical telephone. There is no space in this paper, and not time enough at this meeting, to recount in detail the special features of these ante-telephonic exchanges, but the paper would be incomplete without at least a glance at them. The first idea of exchange work which to my knowledge occurs in history, is found in a British patent issued as far back as February 7th, 1851, to F. M. A. Dumont This clearly describes an exchange system of dial telegraph instruments; connecting by short lines with branch central stations, which branch stations were provided with trunk lines connecting them with a principal station. Some of the sub-station lines converged directly to the main central station. Mr. Dumont showed two forms of switchboard; in one form the lines were connected by flexible conductors having hooks at their ends, and to unite two lines it was only necessary to bring two hooks together.

I show here a picture of the system of lines. The second form of switchboard comprised a number of dials with switches revolving on a pivot at their center, the switch representing a line to be connected with other lines, which latter were represented by metal studs arranged round the switch dials. The idea was far ahead of the times, and I do not know whether it ever went into use.

At a later period after the British postoffice had assimilated the telegraphs of that country, and while the telegraph was still the only means of electrical communication between place and place, the plan of inter communication between sub-stations by means of a switch at a central station was used in England at various places. The postoffice used it at Colchester for the ordinary business between several small towns in that district, and between them and London; and at Newcastle between persons renting private lines; in the former case the Morse sounder was used for signalling, in the latter the Wheatstone dial was employed. In our own country it is well known that large telegraph offices have been almost from the introduction of telegraphy fitted with switchboards whereby different lines could be inter-connected. This was, however, in such cases merely a secondary function, and such inter-connections were chiefly used for the purpose of patching defective lines, for putting several lines together longitudinally to constitute temporally a long through line; or to arrange for some president or general superintendent, who at a watering place or summer resort would upon occasion desire to converse telegraphically with his confidential clerk at the home office.

The very essence of the electrical exchange business is, on the contrary, the continual inter-connection of the various lines. But notwithstanding this difference in function, it is quite obvious that the entire American system of telegraphy has been from the beginning a colossal aggregation of Central offices for telegraphic communications, possessing switch-boards for changing and coupling circuits, electrical apparatus for sending signals, apparatus for receiving signals, and devices for either establishing through commuication between two wires, or terminating one or more circuits at the earth.

In 1869, the Gold & Stock Telegraph company established an exchange system of printing instruments between a number of the banks and the clearing house of New York, which existed in different forms until the telephone made its appearance.

Immediately after the war, Henry Bently established a system of inter-communication at Philadelphia, the lines of which were classified as "telegraph exchange financial and commercial news," "bank lines" and "private and local lines." Scores of business houses and firms were so connected telegraphically at will, through a general central office that they were enabled, whenever desirable, to transact business telegraphically with each other, or with the central station.

Morse keys and sounders were used in this exchange, and the connecting operator at the central station had not only to connect and disconnect the lines, but also to arrange the batteries as the length of combined line varied.

Next comes the exchange system of the Law Telegraph company which was organized in the spring of 1875 It was the result of an idea of Wm. A. Childs to whom is due the credit of working it up. This company operated in New York, and placed both a dial telegraph and a call bell, and a Morse key and sounder at each subscribers station. The dials and bells were on private wires converging to a central station, and a number of the Morse instruments were in circuit together upon a call wire also extending to the same central station—much the same in the general way as is the case in the present so called "Law" system. At the said central station was a switch-board and a set of trained operators to work the same. The call was sent in by repeating numbers on the Morse circuit.

Early Telephone Exchange Work.

The telephone as we all know was patented in 1876. It achieved its first great success at the centennial, and the second telephone patent was issued on January 30, 1877. That its applicability to the purpose of inter-communication was from the first appreciated, is abundantly proved by contemporary records. I myself remember being present at a lecture given by Professor Bell at Chickering hall, New York, in May, 1877, where, although there was a good deal of doubt in my mind about the actual existence of a real Watson at the other end; and though the major part of the exhibition feature of the lecture consisted in "waiting for Watson" I clearly gathered from the words of Mr. Bell that in his mind the telephone was to be used as the operative instrument of just such systems as we have now, and whereby a house could be enabled to connect with the butcher, the baker, the candlestick-maker if desired. This impression of the lecture I have always retained with particular sharpness, by reason of the *sotto voce* remark of a jealous Englishman immediately behind me, who, upon the statement made by Professor Bell, said with profound disregard of the rights of the letter H, "I suppose each 'ouse hadded to the circuit would be about one home." He evidently meant one ohm, but as he stated it, the proposition was indisputable. The first telephone line actually built for the purpose was finished on April 4th, 1877, and extended between the office of Charles Williams, jr., at 109 Court street, Boston, and his house at Somerville, Mass.

The First Telephone Exchange.

In 1877 E. T. Holmes was carrying on an electrical burglar alarm business at 342 Washington street, Boston. He had a number of lines already in existence. Telephones were placed at the offices of a number of the subscribers to this system, and by means of a switchboard purchased for the purpose by Mr Holmes, the lines were upon the 17th day of May, 1877, and thereafter, repeatedly placed in inter-communication; the connecting link being simply a double flexible conductor with a central office telephone at all times in the circuit. Calling was done in both directions by means of the burglar alarm apparatus. This was later discontinued because the subscribers were not willing to pay for the luxury, as the telephone was then considered.

The next historical telephone exchange was located in the drug store of Isaac D. Smith, at Hartford, who leased a lot of telephones from the New England Telephone company, and constructed a series of lines from a number of doctors' offices and livery stables to his store, furnished the said telephone to the said doctors and stablemen, established a home-made switch and call bell in his store, and was in the habit of connecting the doctors' lines to one another and to the stables, as they might be called for. This exchange was brought into some local prominence as a railroad accident occurred one night during its existence at Tariffville, on the Connecticut western railroad, and the news coming to Hartford, the doctors were collected to go out on a special train, by means of their telephone, upon call from Mr. Smith, much quicker than they could have been otherwise. But Mr. Smith died and made no sign, and his embryotic exchange was merged into the Hartford Exchanges.

The Commercial Telephone Exchange.

The first city of the world to open a commercial telephone exchange was New Haven, Conn. This was opened to the public on January 28, 1878. The moving spirit in it was Geo. W. Coy. Its establishment was rapidly followed by that of a similar exchange at Meriden, by E. B. Baker, the latter being opened on February 14th, 1878.

From this time onward we can not in this paper follow the history of individual exchanges, but must be content to generalize. It suffices to say that exchanges at Lowell, Albany, Hartford, Holyoke, Springfield, Newport and New York were quickly organized, and the telephone exchange idea was successfully established.

The Era of Competitive and Reckless Construction.

In the year 1878 the Western Union Telegraph company seems to have reached the conclusion that the telephone business would be profitable, and they took a hand in it, and organized exchanges with a good deal of enthusiasm in many of the cities throughout the United States, in competition with the exchanges operating under the Bell Telephone license Looking back we can think and truthfully say, that although such competition was severe for those engaged in it, it became a means for spreading the use of the telephone widely over the land, for the wide establishment of the telephone exchange, and for accustoming the public to the frequent use of the telephone, which no other agency could probably have equaled. The ultimate result was that by the end of the competition in 1880, nearly every important city and town in the United States had a telephone exchange. But there was another result. Such a competition implied usually that the exchange which fully occupied the ground first, held a great point of vantage against the other, which need only be lost by absolute neglect; consequently there was a fierce and extensive rivalry on the construction of lines and in making low rates, which we are still suffering from. The cry was, "Cover the ground. Get your lines up. Give us good construction if possible, but give us the lines, good or bad." We know now that many of the lines built on this principle were bad. Rates were given, upon which the lines certainly had to operate at a loss, but the business was new and this was not seen until later. $36, $24, $22, and nothing per annum was charged. So far as I am aware, Pittsburgh and St Louis only began work at remunerative rates. The Western Union exchanges were mostly fitted with switch boards recommended by that company, most of them having the board known as the universal jack-knife switch. This was a flexible cord board. The lines were usually worked on the closed circuit of battery principle. Being built chiefly by old telegraphers, the lines were usually well constructed of good galvanized iron wire, of sizes varying from number 9 to number 12, and were well insulated upon glass or rubber hooks. The telephones comprised an almost infinite number of styles of Edison transmitter, and half a dozen styles of magneto-telephones; exchanges organized by the Bell telephone interest also chiefly adopted a cord and spring-jack switchboard, known as the Williams standard. Some of us are yet in the harness who remember this board, and its groups of connect-

ing stripes painted with all the hues of the rainbow, and causing the historical coat of Joseph to pale with envy. But in the larger cities many more of the lines were fitted with magneto-bells. There was but a single style of receiving telephone; for a transmitter we had first the Box telephone and from the beginning of 1879 the Blake transmitter. On the other hand, I have reason to believe that the lines constructed by the Bell exchanges were not as substantial as those of the opposition. The wire used at that time was nearly all number 12 galvanized iron; and the insulators were too freequently regarded merely as fastening attachments. While the glass insulator and rubber hook were freely used, the porcelain door-knob attained also an undesirable prevalency. It will be seen that each side had advantages as well as disadvantages. The Bell people had an excellent magneto-bell and generator, which in fact has proved so serviceable that its general style to this day has suffered no change.

But the Western Union people had more experience, and as a rule better lines. Consolidation came along in due course of time, and a new era commenced—an era of rapid and legitimate growth; but the growth was too fast for good work, and was so tremendous that it deceived many of us into believing that the same rate of interest would last forever.

The Plug Switchboard Era.

The next stage in central office history which is to be referred to I have called the plug switchboard era, because, in the first place, I don't know what else to call it; and because, in the second place, a revolution about this time seemed to sweep over the land, flexible conductor boards going into almost complete disuse, and the plug boards being almost universally favored. I should, however, have stated that during all the previous history of the exchanges quite a number of the exchanges had developed switching systems of their own—all, of course, having the same ultimate aim and function, but accomplishing the said functions in different degrees of efficiency. These systems were each and all admired by at least one man. The deviser quite naturally thought there was no exchange system like his; and in truth, he was generally correct in that idea. But the circumstances long proved a bar to uniformity, and was not likely to be a convenience when the time came to connect exchanges, for the manifest excellences of our neighbor's board, which were not so manifest.

But the fruits of ill-considered and reckless construction and low rates began to be apparent. As stronger companies were formed they naturally formed executive committees. The strong points of the average executive committee of an electrical corporation are an innocence of electrical knowledge, an inability to distinguish between the two words, "economy and parsimony," and an indisposition to see that a dollar properly expended to-day means a good many saved throughout the year. Money was scarce; the lines must go up—and the cry was heard, "We must have a cheap switchboard, and cheap lines." The cry was heard, and we got a cheap switchboard—a plug switchboard. I think that though the Gilliland plug switchboard was, so far as electrical connections went, by no means the ideal condition of Cæsar's wife, it was still a necessity of the times. It answered well in the majority of cases, it was easy to understand; easy to handle; and everything about it was accessible. It was a great educator, and on the whole I think it was perhaps, for the reasons stated above, a better switchboard to have round than others more perfect electrically would have been. Its chief weakness was a looseness between the plug and its socket, but it must be confessed that this fault was plain to be seen, and in the power of exchange managers to rectify. Unfortunately many of them did not see the importance of rectifying it; and I have been in central offices where I could give a good blow with my breath, and blow a couple of dozen plugs out of their places. A worse habit developed in this era—the habit of assuming that because the telephone would work as well as it does under the most adverse conditions, we might, therefore, ignore the most ordinary precautions; give it a hard steel wire of any guage from 14 to 20 to work over, insulate our lines with glass, rubber, porcelain knobs or nothing; neglect to solder ground connections or joints, and apparently try in every way to make it as difficult for the telephone current to exist as possible. The fine steel wire mania, it is evident, grew up from the need of strong lines; and as it was seen that steel was strong, the second idea was, that as lines multiplied, available space to bestow them became scarce, and, of course, by using a fine or small wire, we were enabled to put up a great many in a small place. Besides when I go to Jones and tell him I want to attach a wire to his house, he'll let me much quicker if I show him a small one.

But the porcelain knob lunacy is not so easily accounted for. I suppose, first, the unsophisticated exchange man assumed that the only use of an insulator was that of an attachment; that he later undertook to study electricity, and ascertained that porcelain was a non-conductor; and that thereupon he jumped to the conclusion that all porcelain articles must be well adapted for line insulators. How was he to know that the efficiency of an insulator depends as much on its form as on its material? That may be the way the door knob got into the saddle. It stays there because it does not cost much.

By 1882, wires were so multiplied as to be inconvenient. Cables were introduced, and here again we have had to be educated up to the proper point. When first introduced, we most frequently found in them a number 26 conductor, no special insulation, and a wrapped external coating of doubtful durability. In that year also the electric light industry began to assume importance, and we began to see that wherever a telephone wire and an electric light wire came into close conjunction with one another, the weakest went to the wall. This lesson could not, however, be learnt until an object lesson was given, and the Boston central station had to be practically destroyed before this subject was seriously considered, and proper measures taken for the prevention of such evils. In 1882, the American Bell Telephone company, and the Western Electric company came into harmonious relations, and this paved the way for the improvement, and completion of the multiple central office switchboard, and for the beginning of its general introduction into the larger exchanges. During the period which has elapsed between that year and the present time, the wheel of telephonic preference has again swung round; switchboards having plug connectors have in a great measure gone out of favor, and flexible connection switching apparatus is once more preferred.

The Telephone Exchange of 1887.

And at the present time the majority of the larger exchanges are fitted with the multiple switchboard; some degree of uniformity being thus secured. Look at the average exchange of the year of grace, 1887, and then judge whether great progress has not been made during the decade, and also during the latter five years. It is now almost universally recognized that it is a good practice to conduct all or as many as possible of the converging wires into the central station by cables, and also to use cables to carry a number of wires to the district intended to be served. This idea has largely been utilized during the last five years. By its adoption 3,000 lines can easily be conducted into an exchange, where otherwise it would be difficult to introduce 500. Nor is the advance in the number alone of the cables employed; where six years ago, the size of the conductor, and the character of the insulation were hardly considered, we now recognize the necessity of proper electrical dimensions; a high ratio of conductivity; a first-class insulation and plenty of it; and a durable protecting envelope. If, as is in some cases true, these conditions are not obtained, it is not because their necessity is not recognized, but because the purchasing agent or the person or persons controlling the exchequer is by nature incapacitated from perceiving that in our business the best is also the cheapest. Many of the changes of to-day are working a number of under-ground wires. By this practice we have all been educated. Some of us took the honors of underground wires spontaneously; others have had these honors thrust upon them. It can not be denied that these underground wires show a certain amount of sluggishness in their working. Where interference has been intensified, it has usually been traced to absolute leakage occuring at junctions between the underground and overhead sections, or in test boxes, or working vaults. Our progress in underground construction must teach us the necessity of eternal vigilance in construction, especially as regards insulation. While I would not unnecessarily bury wires, I would get the necessary rights and franchises as much as possible, so as to be ready at any time. The first-class exchange of 1887, in addition to being fitted with lightning arresters of proved virtue, are likewise provided with some form of protector against the destructive effect of dynamo currents; and it is gratifying to observe that some exchanges at least, are beginning to see the necessity of protecting both ends of the line; a proceeding which will be remunerated.

In our earlier years it was customary, even in large cities, to connect more than one instrument upon a circuit; and this practice gave rise to a number of inventions intended to individualize the signals, so that only the station called would hear the signal. But these, while curiosities of electrical gymnastics, could not always be relied upon, and our experience of to-day shows that wherever attainable, for a number of reasons, the best individual signal is an individual line.

Another decided advance is the widespread recognition of the fact that intermediate bell magnets or auxiliary bells exercise a much greater retarding effect than is due to their resistance alone. This leads us to the conclusion that we must cut down the introduction of electro-magnets as much as possible, and to the further conclusion that where they can not be dispensed with their helices should be connected in parallelism, wound with coarser wire, or shunted by a differentially wound resistance or by a condenser.

We may also, I think, congratulate ourselves on the almost universal use, in heavily worked offices, of power generators or automatic pole-changers. Where five years ago, only our largest offices possessed these labor-saving appliances, we now find them almost everywhere, and when we consider the ease with which power may now be made available since we have to choose from the water-motor, the gas-engine, the electro-motor energized from an adjacent dynamo, or the battery and pole-changer, it would seem blameworthy to allow any heavily worked office to go unsupplied.

It seems at this point fitting that I should call your attention to the care of the American Bell Telephone company, which not only through its principal patents protects the main portion of the business but continues to purchase from time to time such inventions as promise to be useful to its licensees. The patent which covers the constantly operating generator or pole-changer is a case in point.

Inter-urban lines and other long lines have during the history of the exchanges wonderfully increased both in number and length; and with the general introduction of copper wires more powerful transmitters, and greater intelligence in the users, are giving very satisfactory service. The use of the copper wire I regard as one of the most important advances in our history, and it is with considerable satisfaction that I once more point out that T. B. Doolittle, in advance of the age, strung a hard-drawn copper telephone line in Ansonia, Conn., in 1878; and has always been the persistent advocate of copper line wire. It is proper also that I should call the attention of the association to the fact that the greater efficiency of copper lies not only in the lower specific resistance of that metal but also and chiefly in that it has a very low co-efficient of self-induction — or, in other words, a very small amount of magnetic inertia.

Lines are I think as a rule better constructed now than formerly, and the advantage of giving the telephonic current a better path to travel over; and good insulation to retard the escape of the electrical excitement seems to be better appreciated than ever before. As to the service of to-day I prefer to say little. I think nearly every exchange is better fitted to give good service, and further that the majority of exchanges do give good service. It is however true that good service needs close watching, as the best staff of operators require discipline and constant supervision, and I think the person in charge of the operating room should in all cases be a male; First, because the chief should understand the electrical arrangements intellectually; and it is rare to find a woman capable of such an understanding; secondly, because, I think operators will be more readily amenable to discipline, when exercised by and insisted upon by a man.

Looking back upon the entire field, we can not fail to see that though sometimes it has not been easy to observe the progress from day to day, progress has certainly been made; we are far ahead now of the point where we were either ten or five years ago. We have, however, to make further advance. It is not enough to know that small wire is not conducive either to stability or to good operation; it is not sufficient to know that the porcelain knob is not an insulator; it is not enough to realize that each company ought periodically to test its lines with the galvanometer, and to test for trouble with the same instrument in the hands of a competent electrician; it is not sufficient to know that competent electricians require more than sixty dollars a month; that line-wire joints and ground connections ought to be soldered; that every part of the plant ought to be periodically inspected; that in your business the best supplies are always the cheapest; it is never sufficient only to know the right way. What possible avail can it be if the right thing is not done in the right way, by the right man, and at the right time? "If we know these things, happy are we if we do them."

Mr. Durant stated that the St. Louis exchange had started at $100 a year, on a three years' contract, and that the rates were the same to-day.

MR. BAILEY: I move that the paper of Mr. Lockwood be published in the proceedings of this meeting, and further that the hearty thanks of the Association be tendered to Mr. Fay, Mr. Hall, Mr. Lockwood and Gen. Barney for their able, interesting and instructive papers.

The motion was carried.

MR. HALL: I want to emphasize one point that Mr. Lockwood made, and that is that you cannot get a competent electrician for $60 a month, and I think that one great difficulty with the telephone service to-day is that we have not a proper corps of men trained in the duties of their respective positions. We need better help all through the service, and it is necessary in order to get men to pay them. We are not training up young men in the business. The material that is coming into the telephone service is not what it ought to be to give the best results and provide the men who, in the future, are to fill the responsible positions in our companies.

MR. FAY: In reference to Mr. Lockwood's statement as to the effect of the electro-magnets, I do not think that any member of the Association can do a better thing for himself and his service than to get Van Rysselberghe's treatise on the use of electro-magnets in his simultaneous system of telegraphy and telephony over the same wire. By the use of electro-magnets and condensers, Van Rysselberghe was able to diminish the effect of a Morse current upon a wire, over which the current passed, to such an extent that he could introduce a telephone in the same circuit and carry on conversation without being interrupted by the Morse current, although the Morse signals were passing at the same time—and effect due entirely to the retarding influence of the electro-magnet on the battery current as it came on the line. What an electro-magnet will do with a Morse current it will do with a telephone current.

The president read a letter from the Westinghouse Electric company inviting the members to visit their works.

On motion to Mr. Bailey, the president was instructed to accept the invitation with thanks.

The meeting then adjourned until 10 o'clock Tuesday morning.

TUESDAY MORNING'S SESSION.

The Secretary read letters of regret from Capt. George M. Stone, of Cincinnati and from W. A. Jackson, of Detroit. A congratulatory telegram from Mr. George Worthington, of New York, was read. Letters of invitation to visit their respective works, were read from the Oliver & Robert Wire Company, Limited; and from the Alleghany Co. Light Company.

New York was selected as the place of the next meeting, the time to be fixed by the executive committee.

THE PRESIDENT: The first paper to be read to-day is by Dr. Allan V. Garratt, an explanation of the new system of designating and ordering wires.

MR. GARRATT: When I received the very courteous invitation through your secretary to address you to-day, I was pleased with it as a mark of personal courtesy. Upon a moment's reflection I saw, however, that it was dictated by a desire to call out the opinion and attitude of the National Electric Light association, in regard to the subject of wire gauge; and therefore I say in the name of that body, Greeting! I shall, as far as possible, voice their views, keeping out of the question what I may personally think or believe. When he stood up to advance those principles of astronomical science that have since made him well-known, Sir John Herschell said that when any student enters upon a scientific pursuit, especially at a somewhat advanced period of life, he will find that he not only has much to learn but much also to unlearn, and as a first preparation, therefore, for the course he is about to commence he must loosen his hold on all crude and hastily adopted notions and must strengthen himself by something of an effort and a resolve for the unprejudiced admission of any conclusion which shall appear to be supported by careful observation and logical deduction, even should it prove of a nature adverse to notions he may have formed for himself or have taken up without consideration upon the credit of others. That, in fact, is the beginning of intellectual discipline. So I would say to you to-day, let us lay aside the

traditions which are the common stock of us all in regard to the subject of gauging wires and look at it from a broader standpoint. We are all seeking to speak of the wire gauge question, at all events the electric light men are, I do not know how it may be with the telephone men, because it seems to be a matter of infinite perplexity, and the more we discuss it, and the more we legislate about it, the less we really accomplish, and perhaps the first thing the National Electric Light association is resolved is this: That there is no use at all in attempting to legislate about wire gauges. Such legislation seems to have no more effect than the wind blowing over the house. This association has practically so resolved. In 1886 the Electric Light association passed such a resolution. Such attempts proved thoroughly fruitless and we abandoned them entirely. The next thing we made up our mind to was that we did not want a gauge any way. It seems to be the tendency of the age to express dimensions of all kinds, in trades, by the simplest possible application of the best unit of measure. That belief we have come to from having corresponded with nearly everybody who was personally interested in this subject, and the almost universal reply to letters sent out upon the wire gauge question, has been that they wished to hear nothing more of wire gauges. Perhaps the next most common reply would be. We prefer to designate our wires by their simple diameters; and usually the reply was expressed in the thousandths of an inch. Personally I have corresponded with nearly all the wire makers, drawers, coverers and electric light companies in regard to the use of the metric system and I find the objection is raised that they are unfamiliar with the metre. Few men carry a mental picture of how long it is They can not put their hands out and say, that is a metre. But when I asked them: Can you tell how long a thousandth of an inch is, the reply is: Can you draw on a piece of paper twenty-seven thousandths of inch? No. Well, isn't it just as unfamiliar a unit to you as a millimetre? Yes. They say it is; that small unit of a thousandth of an inch is an unfamiliar one to almost every one, except machinists who are working to thousandths of an inch in construction at all times, and we have come to that conclusion that that unfamiliar unit is not particularly in the way of adopting a system which shall include its use. Six months ago at Philadelphia I presented a view, something the same as I have this morning, only elaborated in a long argument which would be impertinent here and I was instructed to go ahead with my associates and prepare a mathematical table based upon the views adopted at that convention. I have done so, and it is before you this morning. I suppose there is nothing that I know so little about as the telephone. I do not know anything about your requirements for wire or how close you have to work or whether you have to work at all by sizes of wire or anything of the kind. In incandescent electric light work it is a matter of the most vital importance. I understand that in telephoning the question of static capacity comes in in your engineering work. I much regret my inability to speak upon that subject. It is something entirely out of my field of work, and the other ordinary theoretical consideration, I know nothing whatever about it. I trust that it will be brought up upon this floor and will be discussed. About all I can say in regard to these tables is in regard to the way they were made up. Of course in introducing a thing of this kind we had to be extremely careful that the utmost nicety of accuracy should be used. Nearly all the gauge qustions of wire fall back upon weight against conductivity or conductivity against weight. The figures used in this compilation of conductivity or rather its reciprocal resistance was the last determination in regard to the legal ohm. The work was calculated independently by three members of the committee. The idea of our association in regard to its use is this—not to adopt it as a gauge; if we did we never should use it. We realize that the introduction of anything of this kind can not be revolutionary any more than forms of government can be revolutionary—or only exceptionally so. It must be a question of small growth and the electric light men as represented in their convention have virtually voted to do this—to accept these figures as the work of their committee and, in so far as they can do so without directly interfering with their business workings, to specify such wires as they may require in their simple diameter expressed in the tenth of a millimetre and to use the figures which may be set opposite those numbers of resistance, weight and so on as the legal resistance, weight, etc., of wires of that particular size. That you will see is an extremely conservative position to take. There is really no gauge. You will notice number 19 is .9 of a millimetre. In telegraphing, it is difficult to make telegraph operators put in a decimal point. A decimal point is always a possibility of error, and it is simpler to say number 19. So there is a definite set of consecutive numbers which may be used in ordinary work. In talking with a great diversity of people on this subject, I find this —they say that the telephone men will have certain sizes of wire which they must use; the incandescent light men of one particular system must have wire of a certain size; the arc light men will have another; men who make hairpins will have another. They do not care anything about gauge; simply give them something whereby they can express wires of a particular size in the simplest possible way. Now, in the smaller part of this gauge, in the numbers reading from 1 up to 10, and so on, I received, I suppose, a bushel or two of letters from gentlemen—courteous letters which I have been glad to receive, stating, "Your numbers do not come close enough together; we have six numbers in the Birmingham between the two smallest numbers of this gauge." That is very true. It so happens that neither of those Birmingham numbers, however, exactly correspond with what you want. So, instead of ordering No. 1 wire, it is very probable that a man ordering wire of a small size, would specify .123, which would mean 123 tenths of a millimetre. By the simple rule of three, as one is to the property you want, so will one to three be to the property you want to find out. By a simple proportion from this table you have here, you can almost instantly calculate the physical and electrical property of any wire that you want. That is the way that such a table has to be used. I have not the remotest idea that in the very small wires any gauge will ever be adhered to. The Brown & Sharpe and Birmingham gauges are not adhered to, to my knowledge. I do not think you will care, gentlemen, to have me go into these various tables here which were prepared almost exclusively for electric light work. The length per weight of course is a very pertinent thing to a good telephone line and also the weight per link. The sectional area and diameters are matters of simple mathematical calculation. I would say, by the way, that not only were those calculations by different members of the committee, but calculated by different formulæ. Along to the right, the schedule of logarithms of sectional area, etc., is introduced for the benefit of mathematicians and electricians to save them the trouble of hunting up the logarithm. This column number 16 is simply put in for incandescent men or line men. From that number it is the simplest thing in the world to calculate roughly the questions of resistance and conductivity. Over to the right, to familiarize ourselves with this way of designating in comparison with Brown & Sharpe and the Birmingham, I have put tables of the nearest corresponding number of the Brown & Sharpe and Birmingham gauges, and where there are half a dozen numbers of Brown & Sharpe and Birmingham that correspond to one of this metric table, I have figured that very accurately, so that where it leaves off number 3 and begins number 4 of Brown & Sharpe's gauge, that is figured out to a nicety, so that you can see which is absolutely the nearest number.

On motion of Mr. Bailey, a vote of thanks was passed for the able remarks of Dr. Garratt.

MR. LOCKWOOD: It appears to me that there are two points which cover the entire ground of this question; the first of these is, that every gentleman ordering wire should know what kind of wire he wants. The corollary of that is that every manufacturer when he undertakes to fill an order for wire should know what kind of wire the person that orders it wants. That brings me to the second main feature, which is the necessity whereby telegraphic orders can be sent with few words—concise and clear. It seems, therefore, that the full use of a gauge is that it shall be something which shall express intelligently and inelligibly what kind of wire is wanted, and the size of the conductor and that we also need to know what material is wanted. It seems therefore simply to come to this, that if we can get a series of numbers and letters which shall express unmistakably the kind of wire that is wanted, and if we can get gentlemen to make use of that common code, all that is wanted is done. I find that I can not altogether agree with Mr. Garratt further. Everybody here in his boyhood learned long measures—that three barley corns make one inch, 12 inches one foot, etc. I have heard it said that this metric system is a decimal system, and that sooner or later we must come to a decimal system. It seems to me that while we are thinking of the future we must also live in the present. We have got the inch before us and there is no more reason why we shall not express fractions of an inch decimally than fractions of a metre. Thousandths of an inch have grown into regular use as the unit for ordering wire by. It is very easy if we want to know the sectional area to square the diameter. I find that we just as frequently want to know the diameter of the wire as the sectional area. If then we have the sectional area and want the diameter, we have got to divide or make some other arithmetical calculation which will give us the diameter. Squaring the diameter to get the area, is I think easier than to get the diameter from the area. The great point in favor of the thousandth of an inch is that we are all accustomed to it. Another point against the metric system is that if we take the millimetre as a measurement of sectional area or diameter and do not measure the length of the wire by that system, we are measuring the cross section of the wire by one system and the length by another. If we keep inches and yards and miles for length, I think that we should stick to the same system for sectional area and diameter. At the same time I would like to add my word of appreciation of this paper. I think it is an invaluable addition to the literature of the electric age. All of it is work that is good work and we can rely upon the figures.

MR. SARGENT said that he had done some work in connection with the wire gauge for this association, and what made the question very tiresome to him was that after adopting it hardly a single member of the association, he believed, had seen fit to use the gauge. He believed that only himself and one other gentleman, in the whole United States, were consistent with the declaration of the association and used the gauge. He thought the common sense view of the situation was that it would be a comparatively simple matter for any user of wire to say that he would use one particular gauge of the three well known and recognized gauges. He did not see that we needed to do away with the ordinary wire gauge and its convenient numbers.

MR. DOOLITTLE: It is now simply a question of convenience in ordering by simple number whether to use the Birmingham gauge or the Brown & Sharpe, and I recommend the Brown & Sharpe for the reason that it has been adopted by the manufacturers of brass and copper wire, and in ordering wire we simply have to designate the kind of gauge. Of course it is utterly impossible to promulgate any kind of wire gauge and say that it shall be used, particularly in our department, for electric wires are a very small proportion of the total consumption of wire. It is impossible to bring the whole trade of wire to a common gauge, but we can order our wire by thousandths of an inch, and while that would not agree exactly with the numbering, it is near enough so that we can designate it, say a number 14 or number 12, or what not, and it will answer the purpose. If I was going to suggest anything I should suggest that the members in ordering wire should designate the gauge.

R. W. POPE, after describing the difficulties growing out of the present mode of ordering wire, said: I propose the following system, that all existing gauges be tabulated in progressive order from the smallest size to the largest in use. This table could embrace every existing gauge. To each size thus specified assign a carefully selected code word of such a character as to be free from liability to telegraphic or caligraphic errors. Such a table would permit a single word to indicate any existing size of wire according to any gauge now in use. As an example of the proposed system hastily prepared I submit the following: No. 20 American—Apple; No. 20 Birmingham—Banquet; No. 20 Standard—Salad; No. 20—Washburn & Moen—Wagon; 1000 circular mils—Mammoth; $\frac{32}{1000}$ of an inch—Travel. A similar code is already in use by manufacturers of iron pipe for the exact specification of sizes and qualities.

W. E. SARGENT, of Brooklyn, read the following paper on

UNDERGROUND WORK.

In my remarks on underground work last year the style of our creosoted wooden conduit was fully described. In the latter part of December, 1886, in consequence of the passage of an amendment to the existing ordinance by the board of aldermen, the commissioner of city works refused to issue permits for opening the streets. For this reason our underground work has been at a standstill. We had submitted plans for 1887 for six miles of creosoted wooden conduit, which were approved by the subway commissioners, but, for various reasons, an application to the courts for a mandamus has been delayed until now, and a decision is expected in the next few days. The Dorsett conduit, five miles in all, connecting Brooklyn and Williamsburg, when completed, proved to be very defective. The faults in it are due to several causes, but chiefly to carelessness in laying it in the ditch and making the joints. After a great deal of work, occupying all this year, the ducts are now reported ready for occupancy. The Dorsett material is very rough, and at the joints it squeezed through the cracks, making projections that were broken off in the process of clearing out, and brushes had to be run through to clear these pieces out. Even now the ducts are so very rough that a lead cable is badly scratched in hauling in. It was claimed this material was gas-tight, water-tight, and even mud-tight, but all of these things have been found in the ducts and manholes. The only explosion of gas we have had in Brooklyn was in a Dorsett manhole. Recently the elevated railroad people exposed about eight feet of the first creosoted wooden conduit we laid three years ago. There is not the slightest decay externally, and the ducts inside are clean and dry, the friction rollers running as smoothly as when first laid. Looking backwards, we feel that, had we to do the work over again, we should enlarge the ducts to 3x3 inches inside on double or treble their number, because we now see that, with increased diameter necessary in cables and the use of double conductors, our space will soon be exhausted. We had expected to be able to lay six miles of conduit this year, which would make a total of 20 miles. This work was prevented by the conflict of authority between the subway commissioners and the board of aldermen. No change has been made in our plans for distributing, and we expect to do this from terminal poles and housetop fixtures. In the business portion of the town we are able to secure places for fixtures without much trouble, but among residences it is very difficult. We have carried the cables to housetop fixtures, in one case by going through the cellar to the rear of the building, then up the wall to the fixture on the roof. We have a cable box in the cellar, and run all wires in use for that from there. In two other cases we have run a galvanized iron pipe up the face of the building alongside the water spout, and through this carry the cables to the fixtures for distribution.

We are in communication with the elevated railroad people for the purpose of carrying cables and wires on their structure for distributing purposes No terms have been made yet.

The Brooks' cables, covered with pure lead, have now been in service three years; The corrosion of the lead pipe noted last year is still going on, with indications that it will take several years more to reach the insulated wires. The Western Electric cables, lead with a small percentage of tin, placed in the same conduit at the same time, show only a thin hard white scale, with no indications that it is increasing. The New York and New Jersey cables, covered with lead and tin, have been in the conduit about nine months, and they show no corrosion beyond a thin scale. I think we may assume that a composition of lead and tin resists the action of the gases in the underground conduits. We now have eighteen cables, aggregating 1,700 conductors, leading out underground from our Brooklyn central office; 939 of these conductors are in actual service; six cables, aggregating 500 wires, leading out from the Bedford office, 175 of these conductors are in actual service. We have, all told, sixteen miles of cables underground; 1,500 miles of conductors, 900 miles of which are in actual service. The cables leading out from Brooklyn central office range from 900 to 7,180 feet; in Bedford from 460 feet to 2,250 feet. The first cables furnished by the Western Electric company, 100 wires mixed indiscriminately, have been in service since November, 1884, and have given satisfactory service, with one intermission on account of defective terminals. This difficulty seems to have been solved by their last devices for that purpose, and no serious decline in the insulation has occurred for the past two years.

The wire used in all our present cables is .035 to .038 inches diameter, with insulation .075 to .088 inches.

Realizing that metallic circuits will be necessary in underground work, all our cables were ordered twisted in pairs or groups of four. Through a misunderstanding, a portion of the cables were furnished indiscriminately. We now have cables with the conductors related to each other in three different ways. It was found at once that the cross talk between two of a pair, or two of four, was too great for satisfactory service. There is no cross talk between the pairs or the groups of four. One cable of 7,160 feet, 100 wires twisted indiscriminately of the Western Electric manufacture, has some cross talk, but not enough to prevent its use, and 84 of the 100 wires are in active service. The insulation of the cable varies from 650 to 450 megohms

in summer, and the capacity is .227 microfarads per mile. The next in length was made by the New York and New Jersey Telephone company, 6,660 feet with 100 wires twisted in pairs. The cross talk between pairs was so bad we were compelled at once to take measures to remedy it. The joints were opened and the pairs broken up at all the manholes at intervals of about 800 feet. The effect of this work was to reduce the cross talk between pairs and distribute it among all the wires. It may be expected, of course, that more frequent transpositions would make the cable just as good as the Western Electric. This is not practical, and we shall restore the wires to their original relations, grounding the twin wire until the metallic circuit era arrives. The insulation of this cable ranges from 54 to 29 megohms per mile and the capacity is .3 microfarads per mile. Thirty subscribers are working through it. The shorter cables give similar results, diminishing proportionately to the length. To connect our Brooklyn central with branches at Bedford and Williamsburgh will require two and a half to three miles of cable, aad, we believe, if we followed the Western Electric type there would be enough cross talk to make them valueless, or if we ground the twin wire in the New York and New Jersey type we believe there will be retardation enough to make serious trouble. We have therefore decided to make our long trunk lines of copper .050 in diameter and insulation .125 in diameter. This reduces the copper resistance nearly one-half and increases the thickness of the insulation. Sixty wires of this size may be put in 1⅛ inch core, making a cable with an outside diameter of 1½ inches. We are restricted to this size by the two-inch holes in the Dorsett conduit.

Owing to the delays caused by the action of the Board of Aldermen, none of this cable has been made up to show what its electrical qualities will be.

The insulation of the Western Electric cables quoted shows there has been no reduction since the last terminals were put in. The N. Y. & N J. cables do show loss of insulation, but we attribute this to the joints and terminals, our men lacking skill and experience. Time will prove this, and other things being equal, we believe both cables will give good results.

We believe it economical and desirable to have employes capable of doing all kinds of cable work, including joints and terminals, and have two men under instruction for that purpose.

A 25-wire okonite cable was drawn into the creosoted wood on ducts in the summer, when it was moved to make room for more wires. There is no sign of deterioration or decay in the rubber, and the insulation is 150 megohns per mile in water since it was taken out of the conduit.

It is generally believed that rubber cables will be damaged or destroyed by lying in creosoted wooden ducts, unless protected by lead. It would be interesting to make further trials to demonstrate whether tnis be so. For terminal wires leading from the conduit to the building some form of rubber or gutta percha wire is the most convenient.

We expect to move our Brooklyn central office to a new building as soon as we can get permits to open the streets. All our wires will be brought into this building underground. The new office will be equipped with the latest improvements in multiple boards, including metallic circuits. Mr. Sargent presented the subjoined paper:

Chicago Underground and Aerial Cables.

BY B. E. SUNNY.

A mile of Patterson cables has been put down in West Madison street in Chicago, made up of one 150 wire cable and cables of from 25 to 125 conductors containing in all about 200 miles of wire. Number 18 American gauge was used and the insulation and capacity tests are very satisfactory.

These cables were put down to abandon a pole line of 90 wires built about six years ago. Notwithstanding the fact that the wires on the route were badly decayed and contained many defective connections and that the cables were of the best manufacture, the wires on the pole route talked about 25 per cent. better than those in the cables.

The cross talk is only noticable at times, and is not heavy. These cables are laid in a box of creosoted wood and covered with one-quarter inch tarred sheet iron. The box is just big enough to take the cable and no filling of any kind is used. A gang of twenty men put this cable down at a rate of 500 feet per day, finishing up everything excepting the permanent restoration of the pavement. Eleven hundred feet of conduit has been built to carry the cables from the present central office to the new building. The construction includes the use of wrought iron pipe two and one-half inches inside diameter, free from burs and presenting a smooth surface to the cables. The pipes, sixteen of them in all, are spread apart and the interstices filled with concrete. We are putting 18 gauge 200 conductor cables into the pipes, and find that they work smoothly and that a gang of six men can put in 4 pieces of cable 400 feet each per day. The underground cables put down two years ago are giving satisfaction. Recent tests on some of them show an insulation ranging from five to fifteen megohms. One cable put down by the Standard company two years ago indicated a very low insulation on the regular test. We opened the street in two or three places and finally located the fault in a splice. No abrasion of the lead pipe could be noticed, nor was there any superficial evidence of a fault. A piece including the splice was cut out and another piece of cable put in. The piece cut out was laid on a board and shortly it was noticed that water was coming out of the splice through a blow hole the size of a pin in the solder. There was perhaps half a pint of water in the sleeve. It took two years for the fault to develop. In another instance a Standard cable was cut into by plumbers some time last November. In June the insulation was found to be low and when the fault was located it was discovered that the water had gone into the core through a bad cut in the lead and had worked back forty feet requiring new cable to that extent. We have several cables, chiefly aerial that are defective and are being looked up. It requires the constant attention of a galvanometer corps to keep them in good shape. By means of semi-annual tests, defects have been discovered and removed before they had time to affect the service. The trouble from low insulation at the terminals is being overcome by filling the terminals with paraffine wax, or some other insulator, and keeping the terminals well protected from moisture. The trouble outside of the terminals on air cables, is made up of cuts in the lead by hooks cutting through, bullet holes and careless workmen.

The following tests recently made may be of interest: Two wires were selected which ran together through nine cables of seven different styles, a distance of 4.4 miles. The cables are Patterson aerial and underground and Standard aerial and underground, and contain from 50 to 150 wires, each ranging from 18 to 26 gauge. The resistance measures 444 ohms. The first test was made on a day of alternate sunshine and rain, when everything was damp. There was absolutely no cross talk from one wire to the other, and conversation could be carried on freely and without any more effort than on an air line. The introduction of an annunciator drop into the circuit made no difference. A test for insulation showed 400 000 ohms for the distance and a static capacity of 1.4 microfarads. A week later the same wires were used in the same manner with less satisfactory results. The weather was dry and warm. It was found that counting on one could be distinctly followed on the other and vice versa.

The cross talk from the other wires was very noticeable, but not of sufficient volume to disturb the user. Conversation at a distance of eight inches from a fairly adjusted transmitter was indistinct and muffled. With the lips close to the transmitter and by speaking in the usual tone of voice, the results were fairly satisfactory This was particularly true when an air line of one and one-half miles was added. The measurements made after the the test showed the insulation to be 4 megohms for the distance against .4 of a megohm on the previous test, and 1.05 microfared capacity against 1.4. By opening one of the wires at both ends, so that all connection with the earth was removed, conversation could be freely carried on between three parties who were looped in. The first one was 5,0 0 feet from the open end of the cable, and the other 12,000 feet. The only difference noted by the intermediate parties in the working of the wires with the ends open was that the cross talk was much heavier than with the grounds on. The second test indicates conclusively that we have used up all of our margin and that a slight addition to the length of the cables will make the connection of no commercial value. In fact, in ordinary dry, clear weather, conversation is only carried on by frequent repetitions and considerable discomfort. The nine cables included in this test are all in good condition, and with the exception of a few pieces of air cable, are new. On the above circuit there are sixteen terminals in use, but in all cases, except in exchange offices, the cable wires of one cable were connected with those of another at the terminals with kerite or okonite wire, so that the insulation was good at these points. The experience of four years has proven the fallacy of the practice of requiring the manufacturers to furnish a cable showing an insulation of from 300 to 800 megohms per mile. While this insulation can be secured immediately upon the completion of a cable, it is utterly impossible to maintain it. Nor is it desirable to maintain it, for the reason that cross talk is greater on a cable with a "fancy" insulation than in one of a megohm. Subscribers always complain of cross talk when their wires are put into a new cable, but after a few months we hear no more about it. This is not so much because they have become accustomed to the cross talk as it is that with the lowering of the insulation the cross talk is decreased. A better specification would be one megohm per mile and not more than five, and a guarantee from the manufacturer that this insulation will hold up for ten years. Such an insulation exceeds anything that we are able to get on air lines. In a recent test nine wires showed each an insulation of 5.3 megohms Rain began to fall, and in ten minutes the insulation had fallen off to 3.2, and no doubt went lower. This illustrates the extreme sensitiveness of a high insulation to moisture and indicates clearly that where there is a large number of cables in use the conditions are constantly varying, and nothing like uniformity in the working of the wires can be expected or secured.

Mr. Sargent hen read the following letter from W. J. Denver, general manager of the New England Telephone & Telegraph company: Referring to your inquiry about underground conduits for telephone cables in Boston, allow me to state as follows:—In October and November, 1882, we laid 1,157 feet 8-pipe conduit, 710 feet 6-pipe conduit, and 704 feet 4-pipe conduit. The conduits consisting of three-inch iron pipes, laid in and covered with cement concrete, making for the 8-pipe portion a conduit 2½ feet wide and 1½ feet high. During the summer of 1886, 1,400 feet 6-duct conduits made of creosoted pine were laid down and later in 1886, 5,300 feet 12-duct conduits, 2,760 feet 9-duct conduits all of creosoted pine. These 9-duct conduits are each 16 feet long and 13 inches square. The tops, bottoms and sides are two inches thick, and the inside frame work one inch thick. Each duct is about 2⅓ inches square. All joints, flaws, etc., are coated with boiling pitch. The joints between sections are covered with two thicknesses of tar paper, with hot pitch underneath, between each thickness and over the outside; on top on the conduits are nailed two-inch spruce planks, so laid as to break joints The man-holes are about 500 feet apart and consist of brick chambers from 3 feet by 4 feet 4 inches, to 4 feet 4 inches by 4 feet 4 inches, 7 feet deep, with 8-inch walls covered with stone flagging upon which rests the iron frame and cover. In May and June of the present year 4,280 feet 9-duct creosoted pine conduit was laid, and later on about 6,000 feet 9-duct conduit of creosoted pine. Altogether we have now laid down about 22,310 feet of conduit with a capacity for 205,700 feet of cable. All of the conduits are in use and in good condition. The following cables bave been laid: 4 cables, 100 conductors each, 1,157 feet long; 2 cables, 200 conductors each, 885 feet long; 3 cables, each 100 conductor, 860 feet long; 1 cable, 100 conductors, 885 feet long; 2 cables, 100 conductors each, 530 feet long; 1 cable, 80 conductors, 885 feet long; 1 cable, 200 conductors, 670 feet long; 1 cable, 100 conductors, 670 feet long; 1 cable, 80 conductors, 670 feet long; 1 cable, 100 conductors and 1 cable, 80 conductors 800 feet long; 1 80-conductor and 1 50-conductor cable, each 1,200 feet long. 1 80-conductor cable 2,650 feet long, and two 100 conductor cables, each 1,400 feet long. Altogether we are working about 24,000 feet of cable underground. All of the above is Patterson cable and in good order. One of these cables was laid in February, 1883, and was partially destroyed by electric light trouble on its outside aerial extension, but was cut off and used again, and three others laid at the same time were drawn into one tube. When first laid they were supposed to have been strained and were abandoned on account of grounding. Later on, however, it appears that the moisture resulted from imperfect jointing at the underground terminals, and upon being cut back to the next manhole, they were found to be all right, and have worked satisfactorily ever since. The standard cable now used is as follows:

50 conductor number 18 B. and S. gauge, capacity not more than .20 microfarads per mile, diameter 1⅛ inches. 100 conductors number 18 B. and S. gauage, capacity not more th 17 microfarads per mile, diameter 1⅞ inches

Our electrician, Mr. Farnham, states that other conditions being the same, he has been unable to detect any difference in talking through Patterson cable, whether underground or overhead, the lead pipe contains so much metal in proportion to the conductors, that it gives all the retarding effect possible. Measurements for static capacity seem to confirm this opinion. Difficulty in working cables will come, not so much from connection about town as from long air lines connected with cables. We have had made and laid underground a Patterson cable of 81 conductors, which is the longest length of continuous cable we have, being 6,567 feet long, all under ground. A description of this cable is as follows: Total number of conductors, 81; 80 conductors are number 16, B. and S. gauge, .505 inch; resistance per mile 21.8 ohms; resistance per piece 27.1 ohms; static capacity .214 microfarads per mile; one conductor, number 20, B. and S. gauge .0319 inch; resistance per mile 56.2 ohms; resistance per piece 68.7 ohms; capacity per mile .177 microfarads. When wires not in use are grounded, but little cross talk is noticed. It seems to be advisable that all cables should be of as low static capacity as possible.

After reading the foregoing paper and letters, Mr. Sargent continued:

There is a great want of knowledge among users of cables as to the best forms, size and dimensions necessary to be able to predict with reasonable accuracy what results may be expected from any given length of cable.

The results obtained by the American Telephone & Telegraph company, in operating long distance communications by means of large copper metallic circuits and improved transmitters has brought into prominence the necessity for a higher degree of efficiency in exchange work. It would seem as though enough experience has been had, if formulated properly, to guide our efforts to higher efficiency. With this end in view, E. J. Hall jr. of the American Telegraph & Telephone company, recently invited a few telephone men living in the neighborhood of New York, to meet at his office for the purpose of discussing the subject of telephone cables, and making an effort to define the qualities that are needed for good work.

Dr. Jaques, electrician of the American Bell Telephone company read a very interesting paper on the results obtained on a very large number of lines varying in length, resistance and capacity, and from these results offers a formula for calculating the requirements for good commercial talking to any required distance. His definition of a good line is very good, although I think many exchange lines would be disqualified by his standard. It is, that when two persons not experienced telephone experts are able to carry on a conversation without repeating or at least no more than speaking face to face. He believes that the readiness with which telephone conversation may be carried on depends on: First, the total electrical resistance of the circuit forming the two stations; second, on the total electro-static capacity of this circuit; that no matter what may be the distance between two points, good business conversation may be carried on between them, provided they be connected by a pole line or cable or both, the product of whose total resistance by its total capacity is less than 2,000 for Blake transmitters, and 4,500 for the Hunnings transmitters. He claims that by this formula it is possible to write a specification for any line it may be desired to build. This formula applied to several lines leading out of New York city seemed to prove its truth. The specifications for a standard cable meeting all the requirements of telephone work are confined within narrow limits, on account of the necessary multiplicity of wires and lack of space in all large cities. J. P. Davis, consulting manager of the American Bell Telephone company, states that .125 of an inch is all that can be allowed in New York City for one wire. It was also agreed that the best way of wiring new multiple boards, is to make them up for metallic circuits at once, placing one ground, as long as they remain, in the subscriber's office, and the other at the point where the twin wire ends. Realizing the importance of the conclusions arrived at by the conference, the Metropolitan company has decided to wire its new collossal board in this way, and the new switches for Buffalo and Brooklyn will be wired in the same way. This will place the central office on a loop, which can be completed at any time.

Mr. Bailey having asked for information as to the process by which Mr. Sargent spliced his cables, the president called on Mr. Patterson to give a description of the method.

Mr. Patterson: The only thing to look out for in making a joint in a lead covered cable is to keep out moisture. The ends of the cable, after the cable is made, should always be sorted out. Then after the cable is drawn into a conduit the end of the pipe is cut off and the pipe removed from the core for a distance back corresponding to the

size of the cable. For a 100-wire cable we would want to strip about 18 or 24 inches on each end. On the new style of cables arranged for metallic circuit, each pair of conductors are twisted together and served with a single splint of cotton. The serving around the two wires will hold them in place until the man who is doing the splicing deliberately removes it. One is covered with white cotton and one with red and white—some color that can be easily distinguished. The two wires are brought together, and the way we generally make a splice, and the best way, I think, is to strip the wires for an inch and a half, bring them together, and instead of making a long splice, bend them up and then twist the ends together. That will leave the wire running through and the two ends twisted together standing at right angles to it. A cotton sleeve is drawn over it. This sleeve is like the outer braiding of office wire. After all the wires are spliced in that way they should receive a bath in very hot paraffine poured on while they are laid out loosely to remove moisture which they may gather from the atmosphere, and from the hands of the men. Then the core should be covered and brought down to a compact size so that the lead sleeve will slip back over it. After that sleeve is on it should receive another paraffine bath. After the work is all done it is well to take a torch or something of the kind and pass it along underneath the cable and melt the insulation for a distance of one or two feet each side so as put on a pressure and test the joints; if there is any flaw it will show itself by the paraffine oozing when the pressure is put on. Occasionally, in underground work, it is not convenient to make a sleeved pipe. In that case we turn both ends of the cable up and bring them out through the top and have a brass casting in the form of an inverted Y. The two branches of the Y are of such size that the cable pipe will slip into them and the main outlet is large enough to make the splice. The wires are brought up through there and spliced together, and the opening covered by a cap. After the work is done that Y is dropped down into the hole and lifted. That removes the necessity of doing the work in the man-hole. It is lifted up to the level of the street and the man sits on the edge with his feet inside and works on it.

MR. SEELEY: In New York city the Metropolitan company have something like eighteen miles of underground cable. It consists of three different systems—the Edison, the Brooks and the Western Electric. We have nine miles of the Western Electric in Sixth avenue. The longest length is two miles. We have had one explosion with the Dorsett system. The conduit is very rough, scratching all the lead pipe from the cables when they are pulled through. We have no trouble in making out underground joints; we let the Western Electric do that for us. But on our aerial cables, we have a plumber who makes those joints as Mr. Patterson has described. The only difficulty we have had with any underground system has been with the Brooks system. A short while ago 400 wires failed. We traced it to the terminals, where there was some water. We were compelled to draw the cable out and boil it. It worked well after being put back. Our insulation ranges from 500 megohms to one megohm. The Brooks system measures very much lower than that. The longest length of the Brooks is 1,900 feet. The static capacity ranges from .12 to .13 microfarad, and, on moderate insulation, say one megohm per mile.

THE PRESIDENT: What is the result of your investigation in regard to Brooks cable as to cross talk?

MR. SEELEY: There is some cross talk in the Brooks cables. I never saw a cable yet but that there was some leakage or cross talk. We are compelled to ground all the wires that are not in use. Of course that cuts down the cross talk considerably. The president of our company has decided to use metallic circuits in the future for all our subscribers. Our cables will consist of the number 18 Brown & Sharpe gauge, with a static capacity of .21 of a microfarad. Instead of putting 100 single wires in a cable, we are going to put 100 metallic circuits in a cable. As the subscriber's lines are gradually turned into metallic circuits, we will use the wires, and we will ground one side of the circuit until that time comes. We have cables in New York city, number 14, number 16, and number 18 American gauge. We talk as well on a number 18 wire as we do on a number 14. We have no underground cables under number 20. We have 20 miles of Patterson cable—that is, 20 and 26-wire. We also have some long kerite cables. The static capacity ranges from .25 to .30 of a microfarad. We have a cable running from our testing house to Mr. Sargent's exchange in Brooklyn, which has been there some sixteen months—a Patterson cable. I think that is a number 14 cable. They are grounded circuits. Our original intention was to use them as metallic circuits some future day.

E. J. HALL, jr.: There has been an impression that we might after while take out our cables and rearrange the connections so as to adapt the present grounded circuits for metallic circuit use, but a little reflection will satisfy anyone that that is not possible. When you come to think of the complications involved in doing any work on cables underground, and then imagine a conduit filled with lead cable! On the cable running through Sixth avenue, New York—about two miles, we tried the experiment practically of working a cable 2¼ miles long, which is giving good results when used for grounded circuits. As a metallic circuit cable the line worked so badly that we asked Mr. Eckert to take the conductors out of the cable and give us some overhead wires, which he did, and the trouble was removed. The difficulty was simply this: In working a ground circuit through a cable, indiscriminately, 2¼ miles long, you have 2¼ miles of exposure of the conductor to interference from other wires. When you bring the return conductor back through that cable you have 4½ exposed to induction from single wires for the reason that the wires in the metallic circuit are not affected equally by the disturbance. They are not parallel and they are not made up with reference to the other wires in the cable. You start in at one end with number 1 and number 2 wires immediately adjoining, but at the first joint the wires have been taken up so that they do not continue in the same parallel relation.

MR. SEELY: The present condition of our underground cables, of course, is not satisfactory; if it were, we would not go to the enormous expense of making every subscriber a metallic circuit. We have more electric lights, more telegraph wires, and more of all kinds of induction in New York than anywhere else. Induction does not come from the underground cables; it is brought into the cables from the overhead wires.

E. J. Hall, jr.: I would like to make one statement further, which I think may interest you. We recently worked a line between Philadelphia and New Haven, about 175 miles, in which there were about 18 miles of cable, that cable being made up of aerial, underground and underwater—15 miles of that was continuous at one time. That working on metallic circuit has been operated with entire satisfaction. So I do not think that we need fear in any of our cities, we will strike a limit over which we can not talk successfully, even though we used cables entirely. It was an experimental test and the cables were connected up for the purpose of making the test.

MR. BENNETT: What will that do practically when you have got fifty subscribers in a 100-conductor cable to a metallic circuit?

MR. HALL: It will work just exactly as well if the cables are constructed with reference to using metallic circuits.

MR. BENNETT: The men who are putting their money in telephone stock want to get the best possible appliances they can to continue the business practically. Two years ago there was nobody talking metallic circuits. You state in this convention that you have got so many miles of wire. You have got a subscriber 100 feet from your exchange. You tell us he is on a metallic circuit; that is 200 feet of underground work for that one subscriber. Why not simply say that you have so many subscribers and it takes so many miles of wire to those subscribers?

MR. SEELY: I stated emphatically that our cables were in miles—18 miles of underground cable—not wire; longest length, 2 miles; shortest length 1,900 feet.

MR. BENNETT: How many subscribers have you got on those wires?

MR. SEELY: Three thousand.

MR. BENNETT: How many wires in a cable?

MR. SEELY: From 400 to 100.

MR. BENNETT: How many wires for the 300 subscribers?

MR. SEELY: Three thousand.

This brought the discussion to a close and the meeting adjourned.

EXHIBITS.

In the hotel the Standard Underground Cable company, of Pittsburgh, showed a number of samples of the well-known cable.

The Western Electric company, of Chicago, exhibited a section of their new style multiple switch board.

The Eastern Electric Cable company, of Boston, Mass., also showed specimens of their cables.

Among other exhibitors were Clark B. Hotchkiss, who displayed specimens of Day's kerite wires, and the National Conduit Manufacturing company, of New York, who make a cement lined underground conduit.

SOCIAL FEATURES.

Tuesday afternoon, on invitation of President Metzger, the delegates to the convention enjoyed a trip on the river on the Mayflower, and visited the Edgar Thompson Steel works of Carnegie Bros. Despite the drizzly weather, the party had a most enjoyable time. A number of ladies lent their grace to the occasion, and an elegant lunch served aboard the steamer added its quota to the enjoyment of the trip. The vote of thanks tendered the president was supplemented by three rousing cheers, enforced by a royal tiger.

THE ELECTRIC LIGHT.

The work of laying Edison wires in the streets of Chicago, temporarily suspended, has been resumed. The wires are being laid closer to the curbs, in accordance with the suggestion of the commissioner of public works.

The feasibility and practicability of putting wires underground is a question that is being actively discussed in Detroit. A party of city officials are about to make a tour of the principal cities in which the wires have been put underground to thoroughly study the matter.

The city of Shelbyville, Ill., was lighted the 22nd ult. by electricity. The Shelbyville Water company has added a large dynamo to its extensive works, and will hereafter supply electric lights for the city.

A resident of Easton, Penn., writes: "Our lights cost about $6,000 the first year. We have superintendent, $400 a year, engineer, $50 a month, fireman, $42,50, and two linemen, $36 a month. We have 66 arc lights and burn them every dark night, and when there is no prospect of moonlight, and from dark to dawn. They are of 2,000 candle-power. Steam is our motive power. We have three 25-light dynamos, and two 60 horse-power Ide engines, 12 miles of wire, and two boilers of 70 horse power each. We have the Western electric light system of Chicago, Ill., and the entire plant cost the city $19,800."

THE ELECTRIC MOTOR.

Work was began on the 19th ult., on the Brainerd street railroad at Brainerd, Minn. The cars will be run by electricity.

The Big Bend Tunnel and Mining company, of Butte county, California, R. V. Pierce, president, Buffalo, N. Y., have recently issued a bulletin in regard to the operations at the mine. The bulletin concludes: "By putting in a plant of water wheels, and through the medium of dynamo-electric machines, converting the power obtained into electricity, it will be a simple and not very expensive undertaking to distribute the power to the different points on the river, where it may be utilized to great advantage. It is believed that such a plant as will enable us to bring into our service the vast power at our command, and in such a portable and convenient form as to enable us to switch it off and employ it at any point where desired; and to divide it up and use it at many different places, all at the same time, will greatly facilitate and cheapen the various processes necessary to the successful working of the extensive auriferous gravel deposits with which our river-bed abounds. Competent electricians will be employed, to act in concert with the company's mining engineer, in devising the most practical plan of utilizing an ample amount of our water-power in some such manner as herein indicated, to the end that we may carry on all our mining operations with the greatest economy as well as with the utmost dispatch."

A plan has been proposed for transmitting power by electricity to the city of Valencia in Spain, which is a manufacturing town of importance. The power is to be obtained from the river Turia, about 35 miles from the city, at a point where the stream describes roughly a semicircular arc. Along a chord of this arc, measuring 1.37 miles in length, it is proposed to cut a canal, at an almost horizontal level, thus obtaining at the outlet a fall of 108 ft. to the bed of the river. The line of the canal is, however, intersected by a range of rugged hills, under which it may be necessary to tunnel for a distance of rather more than a mile. The intake will be effected at a point where the river issues from a deep and narrow ravine, the Pass of Cingdos, and this configuration offers peculiar advantages for impounding the flow and constructing the necessary dam and sluices. At the farther end of the canal the ground is favorable for the construction of a reservior upon the higher level, and for the erection of the machine-house upon the river bank. The mean annual volume of water to be dealt with is stated, after numerous experiments, to amount to 353 cubic feet per second, which, under a head of 108 feet will be found to account for 4,200 horse-power (theoretical). It is proposed to utilize this force by means of Jonval turbines, for which an efficiency of 70 per cent. is assumed, thus yielding a brake horse-power of 2,940, or, say, 3,000. This 3,000 horse-power will be transmitted to Valencia by electricity, and the projectors have calculated a large return on the investment required. The cost of the dam and other works is estimated at about $665,000.

In a flouring mill to be erected at Laramie, Wyoming, two electric motors, each of 20 horse-power, will be used; one for driving the machinery on the first and second floors, and the other for driving the machinery above these floors. The current is to be supplied by the Edison electric light station located a few hundred feet away. The expense for power will be one dollar per hour, which, considering the high cost of coal in that section, is certainly very reasonable, while the safety from fire makes a material saving in the cost of insurance.

THE TELEGRAPH.

Telegraph operators have a "ha-ha" way of laughing a long distance; but like the British "hear! hear!" written in speeches before delivery, the wire laughter is not catching, truly remarks the *Picayune*.

A telegraph office has been opened at Tobermory, Bruce peninsula, lying between Georgian bay and Lake Erie. The meteorological department will shortly establish a storm drum at that point. The government, in the interest of the shipping community, contributed toward the expense of extending the line to Tobemorry.

THE TELEPHONE.

The St. Paul, Minn., board of trade at a recent meeting resolved: "That in the opinion of this board, the price charged for the telephone service is exorbitant, and that a committee be appointed to confer with a committee of the chamber of commerce, with a view of obtaining a reduction in price, or an entire abandonment of its use in this city."

In Cincinnati, on the 14th ult., the city solicitor rendered a decision that the city council has no power to pass an ordinance compelling telegraph and telephone companies to put their wires underground, for the reason that their rights are derived from the state law.

NEW ENTERPRISES.

M. F. Davis, of Kansas City, Mo., will erect a two-story residence to cost $4,500. It will be fitted with electric bells.

Max Isaac, of the same city, will build a handsome three-story residence to cost $10,000. It will also be provided with electric appliances.

Lewis Walferman, also of Kansas City, will erect a residence of two-stories, to cost $4,500 and to be provided with electric bells.

At Kansas City, L. E. Brindle, of 631 Woodland avenue, will build a residence block of four stories, to cost $25,000, electric bells will be put in.

Judge S. C. Douglas, 18 Delaware block, Kansas City, Mo., is about to build a handsome residence of four-stories, estimated cost $50,000. It will be provided with all the latest improvements including electric appliances.

The Griffin Cotton Factory Company, Griffin, Ga., propose to erect another cotton factory similar to that now in operation, at a cost of about $200,000.

The Tallahoosa Land, Mining and Manufacturing company, of Tallahoosa, Ga., will enlarge their hotel at that place. G. W. Adair, of 5 Kimball house, Wall street, Atlanta, Ga., is president of the company.

A cotton mill is projected at Topeka, Kan. J. W. Magill, 110 West Eighth street, Topeka, is identified with the enterprise.

Miscellaneous Notes.

In a bookstore in Boston is displayed a remarkable photograph. It represents a landscape shrouded in darkness, while across the sky in the very center of the picture is a broad and wonderfully well-defined flash of lightning. The photograph is the work of A. H. Binden, a skillful amateur photographer. It was taken on the evening of July 29th, from a window of his house at Wakefield. The time was about sunset. A severe storm had just passed over, and a second, accompanied by thunder and lightning was just coming up. The close proximity of evening, combined with the thick clouds, rendered it almost completely dark, though the landscape was still well defined in a shadowy outline. Mr. Binden was aware that many attempts have been made by photographers, both amateur and professional, to produce a well-defined photograph of a flash of lightning. These attempts have usually been fruitless, one instance being upon record in which an operator spoiled 172 plates before producing a result at all satisfactory. But he resolved to attempt the problem and from his chamber window trained his camera upon the point of the compass where the electric flashes appeared. As well as was possible in the gathering darkness, he focussed the landscape properly and awaited his opportunity. In a moment it came, a blinding flash, lighting up the entire landscape. Instantly the plate was exposed, and a few moments later Mr. Binden was delighted to discover that he scored a bull's eye in photography, the broad flash appearing directly in the center of his plate.

R. Nahrwoldt has made a series of experiments on the gradual loss of the electricity of electrified bodies. In an essay published in 1878 the author proved that the discharge takes place by means of the particles of dust suspended in the air. These are electrified and then repelled from the electrifying body. The result of these experiments led Lodge and Von Obermayer to their method of clearing rooms from smoke. Later on, it was shown that a platinum wire made red-hot by electricity, electrified the surrounding air, although it was almost free from dust. For this reason Nahrwoldt resumed his experiments. He found that electricity was discharged through a point only in dusty air. He made his experiments in an air-tight glass shade, the sides of which were covered with a thin layer of glycerine. After the dust was precipitated on the sides of the glass through the action of the electricity, the discharge was very slight. As soon as a platinum wire was electrified, and became red-hot, electricity was again discharged through the point. Nahrwoldt concluded that this was due to particles flying from red-hot wire. This conclusion was proved to be correct by the occurrence of platinum in the deposits on the sides, and by the loss of weight of the wire. These experiments led him to the conclusion that air free of dust can not be electrified statically.

Personal Paragraphs.

Gen. A. K. Stiles of the Van Depoele Electric Mnfg. Co., has returned from his eastern trip.

Superintendent Hewes of the Home Telegraph & Signal company, of Kansas City, Mo., has been appointed to take charge of the bureau of information organized for the benefit of strangers who will visit that city during President Cleveland's brief sojourn.

It is reported that Thomas A. Edison and E. Gilliland are about to build winter homes at the new town of Thermalito, Butte county, California. A large laboratory will be built there, similar to the one erected by Edison at Fort Myers, Florida.

Electrical Patents.

Issued September 20, 1887.

370,052. Signal and Pyrotechnic Electric Light. Arthur C. Ferguson, Saratoga, N. Y. The circuits are controlled by electro-magnetic devices and a revolving circuit closer, arranged to display successively different figures or designs in the same field.

370,123. Electric Meter. Thomas A. Edison, Menlo Park, N. J. The meter is designed especially for measuring the current consumed in a general distribution system of electricity. A uni-polar motor is the most important feature of the invention.

370,124. Manufacture of Filaments for Incandescent Electric Lights. Thomas A. Edison, Menlo Park, N. J. The filament is first carbonized and then heated to high incandescence; after which it is dipped in a solution of sugar or other carbonizable material; it is then dried, and then re-carbonized preferably by electrical heating in a vacuum.

370,125, (1); 370,126, (2); 370,127, (3); 370,128, (4); 370,129, (5); 370,130, (6); 370,131, (7), Electrical Transmission of Power. Thomas A Edison, Menlo Park, N. J.

The above seven cases were filed June 7, 1883.

(1). The dynamos and the motors are arranged in series, and the field coils of each generator and motor are included in a different shunt, adjustable resistance being included in each of the shunts. The number of motors, as well as the number of generators connected together, may thus be varied. Any or all may be provided with shunts for throwing them out of circuit.

(2). The field coils of the generators are in the same shunt circuit, in which is included adjustable resistance. The motors are arranged the same as in case (1).

(3). The field magnets of the generators are placed in a shunt around one or more of the generators, the shunt including adjustable resistance. The field magnets of the motors are arranged in the same manner in series in a shunt around one of the motors, the shunt including adjustable resistance.

(4). The generators are connected with motors, which are connected in multiple arc or multiple series across the main conductor, the piled coils of the motors being in series in a shunt, which shunt includes adjustable resistance, The fields thus receive a lower tension current than when connected across the line, and may, therefore, be wound with coarse wire, thus avoiding danger to the coils.

(5). The electric machines and the motors are arranged in series, the fields of the motors being in a separate local circuit, including a separate dynamo.

(6). Substantially the same as (5), except that the local dynamo is driven by one of the electric motors.

(7). The second claim defines the invention as follows: "The combination of one or more magneto-electric machines, an exciting machine for its or their field magnets, two or more independent electro-dynamic motors connected with said magneto-machines, and a combined generator and motor having its motor-coils in the circuit of said magneto-electric machines, and its generator-coils connected with the field-magnet coils of said electro-dynamic motors, substantially as set forth.

370,132. Telegraphy. Thomas A. Edison, Menlo Park, N. J.

370,134. Secondary Battery. Otis C. Flick, Brooklyn, N. Y. The oxygen plate consists of the per oxide of lead and the hydrogen plate of an amalgam of zinc, mercury and lead. The invention is designed to prevent the formation in the plates of any intervening film or layer of resisting material so that the storage battery may last indefinitely without deteriorating.

370,193. Adjustable Support and Automatic Switch for Telephones. Sylvanus P. Jermain, Toledo, Ohio.

370,230. Auditory Transmitter for Telephones. Herbert Allison, Xenia, Ohio.

370,243. Electric Attachment for Locomotives. Norman F. Chase, Montrose, N. Y.

370,282. Electric Welding and Tempering Metals. Elias E. Ries, Baltimore, Md. The patent includes five method claims and five combination claims, making ten in all. The first claim is as follows: The method, substantially as described, of affecting a hardened or tempered joint between two metals, which consists, first, in placing the adjacent extremities of the respective metals in contact, passing an electric current of heavy heating effect through such abutting ends, and gradually increasing the current strength until they are fused and united, and, secondly, in tempering the joint thus formed by the application of a suitable chilling method of welding or tempering compounds, as specified.

370,283. Underground Conduit for Electric and Other Railways. Elias E. Ries, Baltimore, Md. This invention relates to an underground conduit for the supply-conductors of an electric railway, or for traction-cables of a cable railway or for both the traction cables and supply conductors where the respective systems (cable and electric) traverse in common the same course or street for a certain distance

370,293. Telephone System. Frank C. Watkins, Philadelphia, Pa.

370,328. Fire-Alarm Box. Brown S. Flanders, Boston, Mass.

370,357. Printing Telegraph. Robert J. Sherry, New York, N. Y.

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Chicago Electric Club.

There will be a meeting of the CHICAGO ELECTRIC CLUB, Monday evening, October 3rd, at 8 o'clock, at the rooms of the Club, 223 Dearborn Street.

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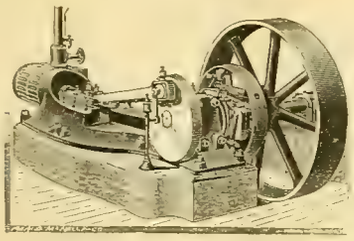

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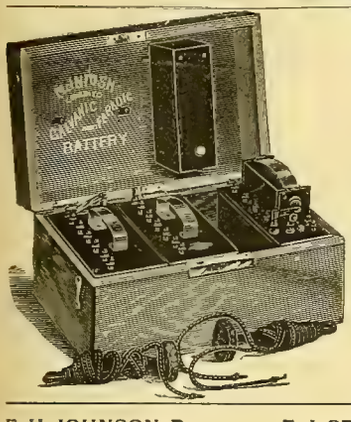

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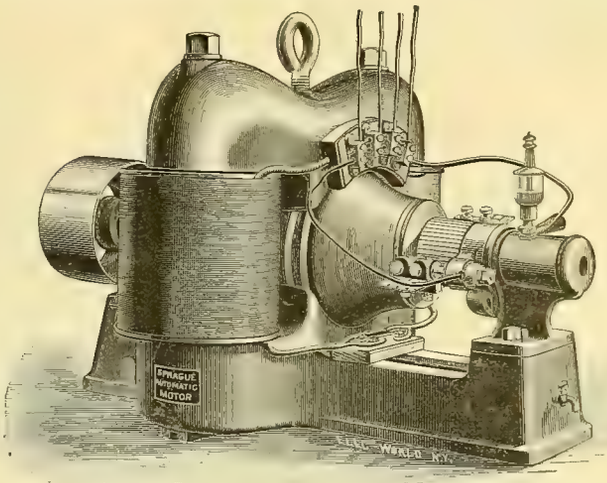

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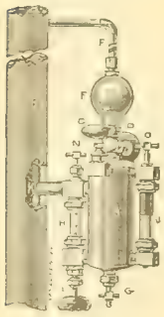

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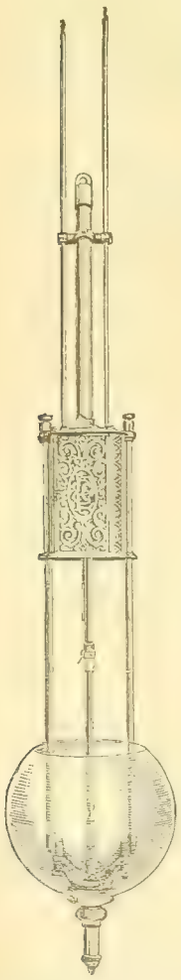

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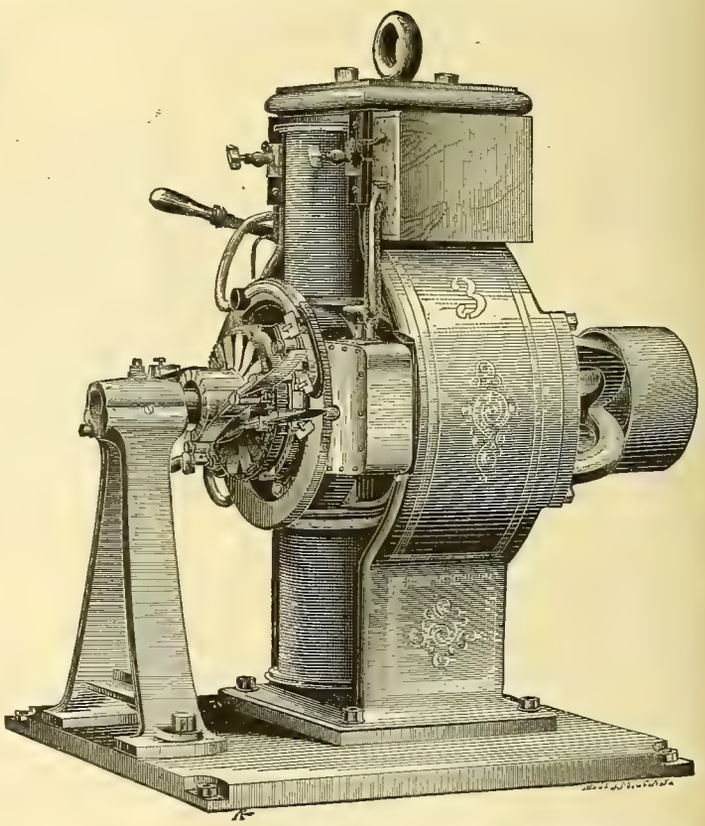

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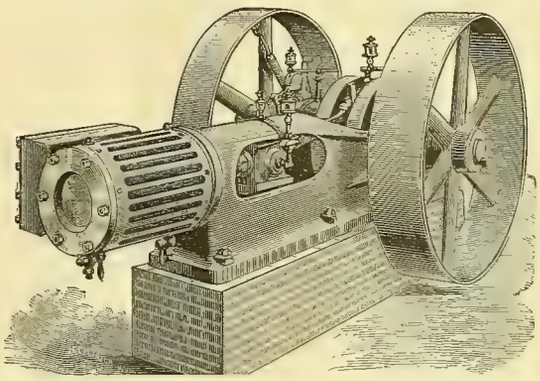

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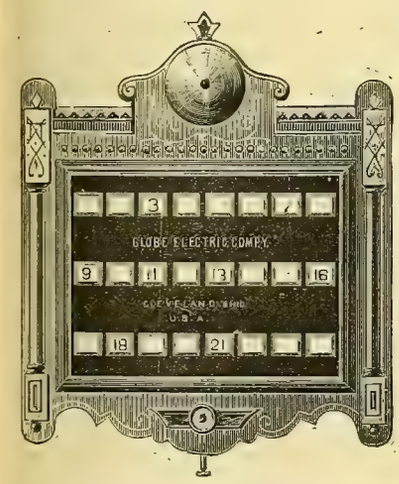

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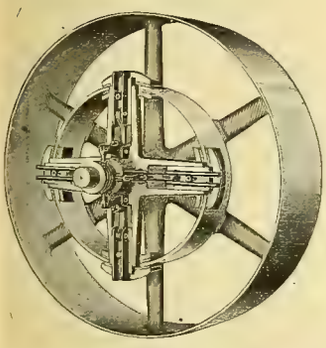

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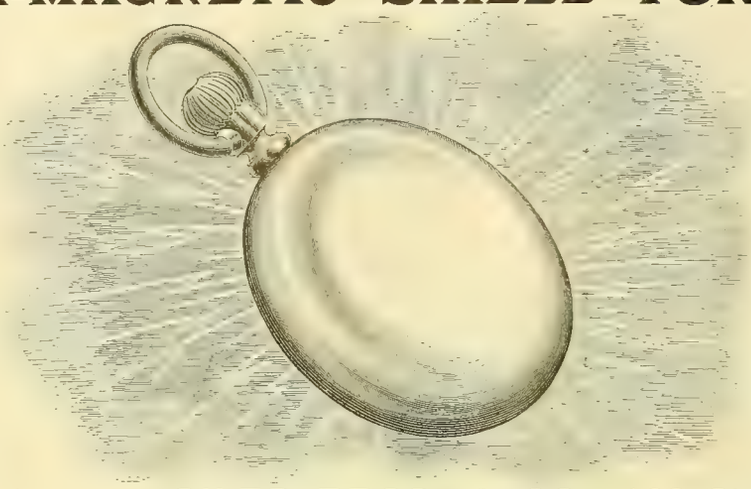

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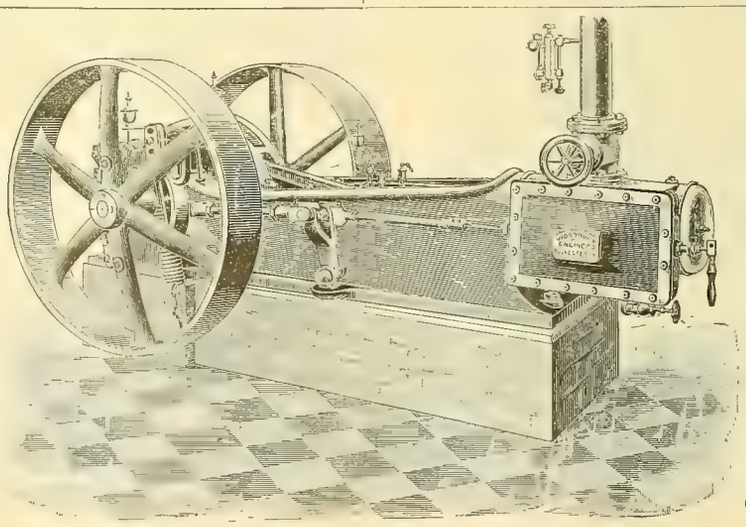

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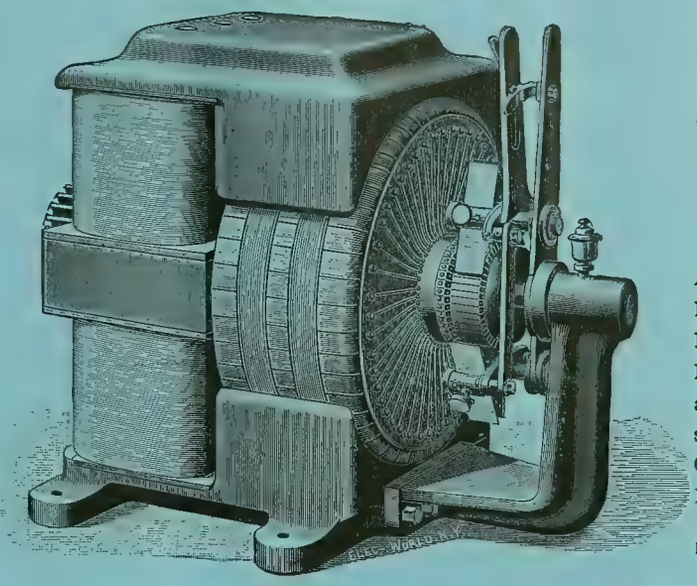

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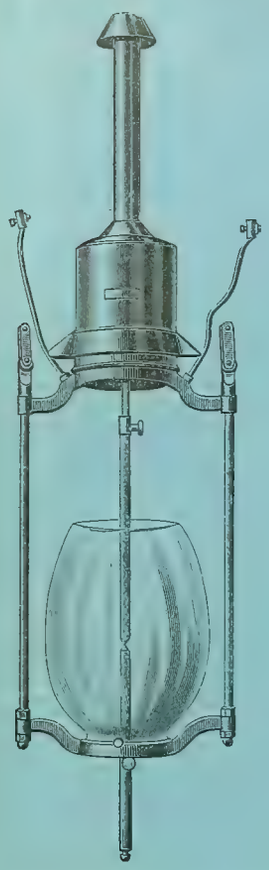

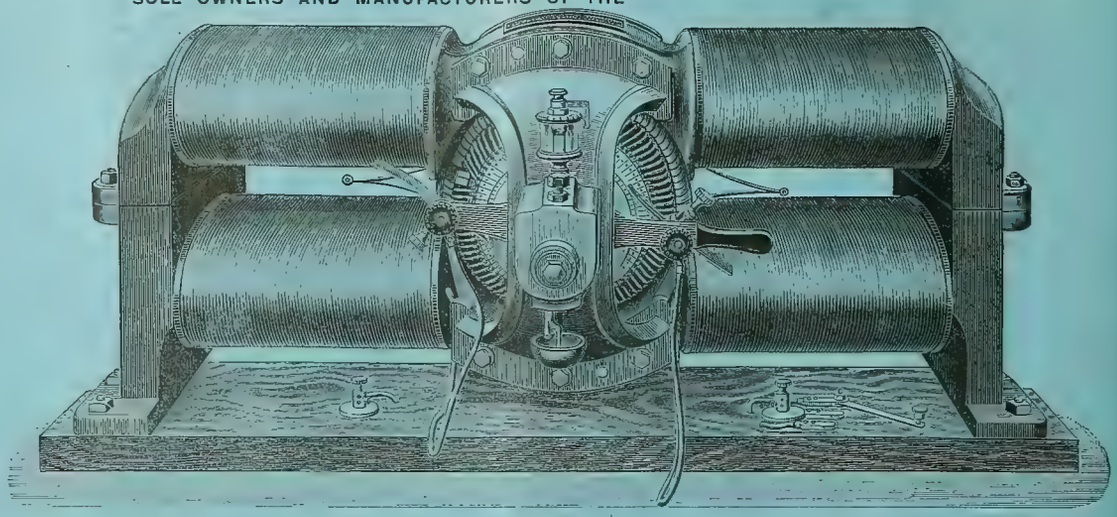

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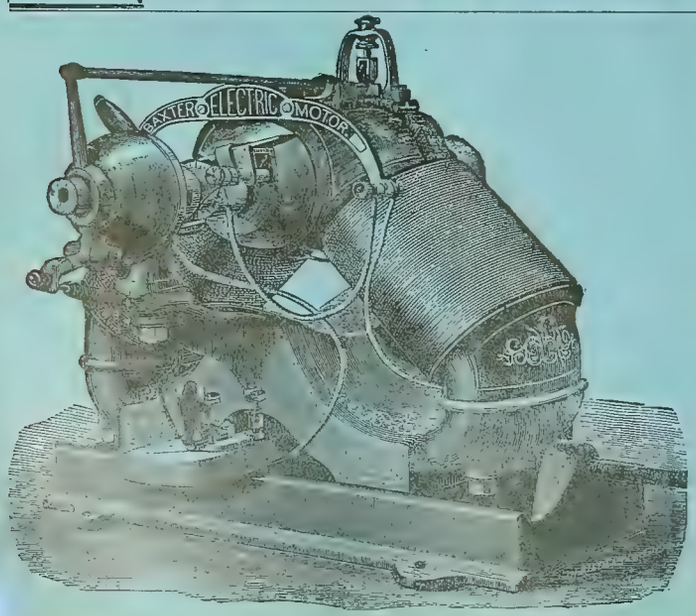

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We have superior advantages for placing patented articles on the market.

Correspondence with inventors solicited.

171 RANDOLPH STREET, CHICAGO.

ELECTRIC LIGHT SUPPLIES A SPECIALTY.

THE ELECTRICAL SUPPLY CO.

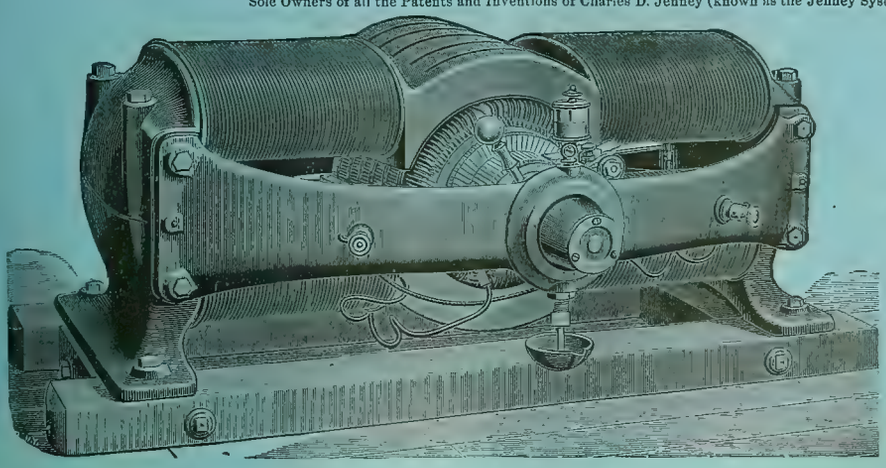
17 Dey Street, NEW YORK. 171 Randolph Street, CHICAGO, ILL.

FACTORIES: ANSONIA, CONN.

DANIEL W. MARMON, President. ADDISON H. NORDYKE, Vice-President. CHARLES D. JENNEY, Electrician BRAINARD ROBISON, Secretary. AMOS K. HOLLOWELL, Treasurer.

JENNEY ELECTRIC COMPANY,

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Arc-Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

or. Kentucky Ave. and Morris St., INDIANAPOLIS, IND.

The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

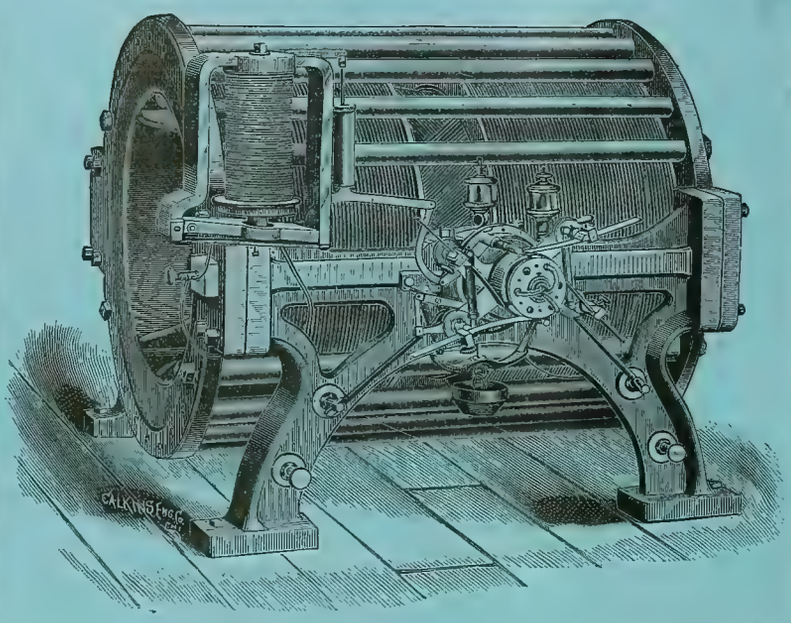
OF

Electric Arc-Lighting

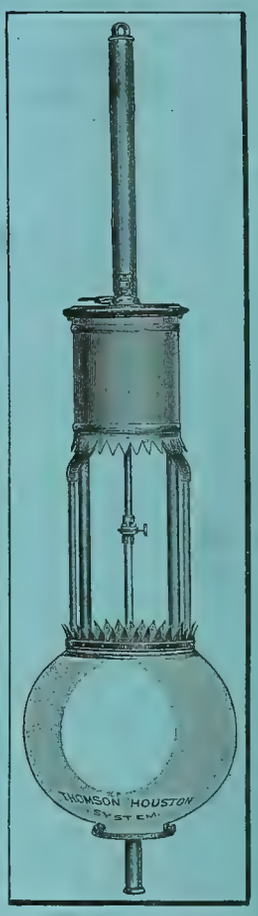
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

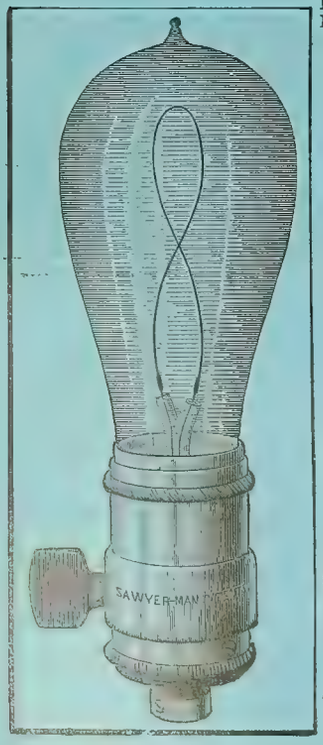


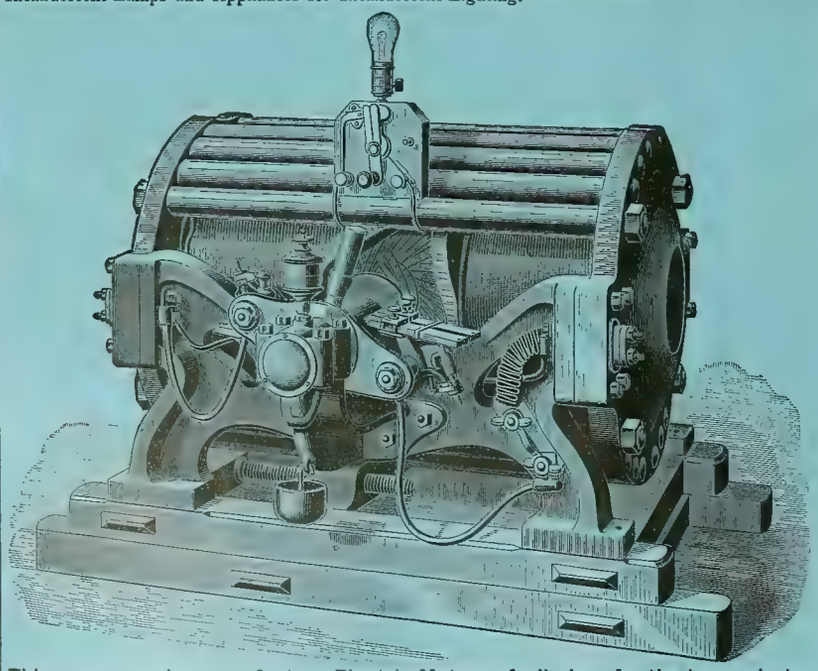
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

THE MATHER ELECTRIC COMPANY

MANCHESTER, CONN.

H. G. CHENEY, Pres. ROBERT CHENEY, Vice-Pres. P. H. WOODWARD, Sec. and Treas. N. T. PULSIFER, Gen'l Mang'r.
R. H. MATHER, WM. A. ANTHONY, Consulting Electricians.

New York Office, 35 Broadway. Chicago Office, 38 LaSalle St. Boston Office, 143 Federal St. Cincinnati Office, Carlisle Building.

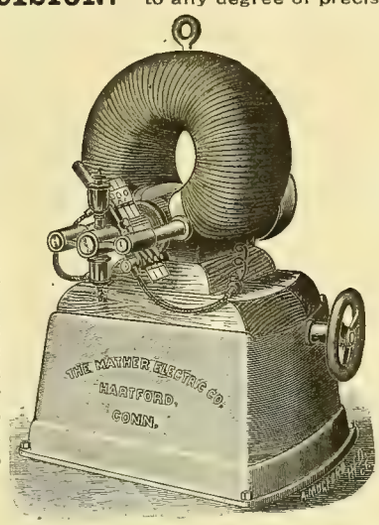
INSTRUMENTS OF PRECISION. We make Instruments for Electrical Measurements, adjusted to any degree of precision required for any purpose.

THE MATHER SYSTEM

—FOR—

Incandescent Lighting.

The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and ***DO NOT BLACKEN IN USE.*** Our Dynamo is very simple in construction, runs without spark at the commutators and can be operated by any one accustomed to the care of engines or machinery. The system has no equal for mills, machine shops, or other places requiring isolated plants. We shall be pleased to furnish estimates for complete installations, with or without motive power, and will send one of our experts to examine the premises, if necessary.



MOTORS.

We furnish motors from one-half horse power upwards, for constant potential circuits, perfectly self-regulating without special regulating mechanism. Motors are also furnished for constant current circuit.

Incandescent Lamps and Sockets

FOR PRIVATE USERS.

We furnish Lamps of 16 Candle Power each, for Potentials from 50 to 110 Volts, for use with any Machine.

CHICAGO OFFICE: 38 LA SALLE STREET.

THE TUCKER ELECTRICAL MANUFACTURING COMPANY, 35 Broadway, New York City,

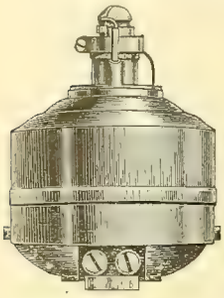
SOLE AGENTS FOR THE MATHER ELECTRIC COMPANY FOR THE STATES OF NEW YORK, NEW JERSEY MISSOURI AND IOWA.

THE NATIONAL CARBON CO.

CLEVELAND, O.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



Cleverly Electrical Works,

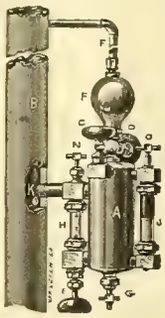
1018 Chestnut St., PHILADELPHIA.

"IMPROVED" AUTOMATIC BURNER

On the Automatic Burners the electricity not only lights the gas, but turns it on and off by means of the push buttons, or keys.

The Automatic has been greatly improved, and is fitted with binding posts instead of the loose wires as formerly and new form of shell.

The improved Automatic and Pendant Burners are guaranteed to be reliable, safe, and of first-class workmanship.



The Detroit Sight Feed Lubricators

Are pronounced the best by more than **20,000** users. They are especially adapted to

HIGH SPEED ENGINES FOR ELECTRIC LIGHTING

Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

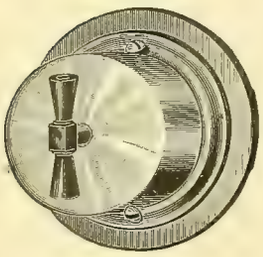
Liberal discount to the trade. Send for Circular and Price List.

DETROIT LUBRICATOR CO.

Office, 11 Rowland Street, - DETROIT, MICH.

FOREST CITY ELECTRIC WORKS,

MANUFACTURERS OF

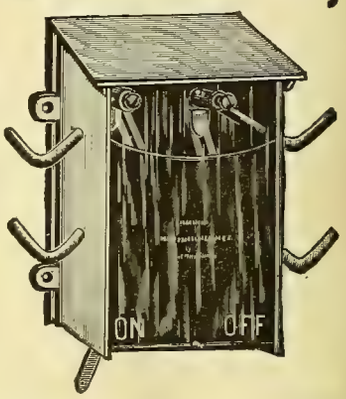


Cleveland's Electric Light Cut-outs,

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.

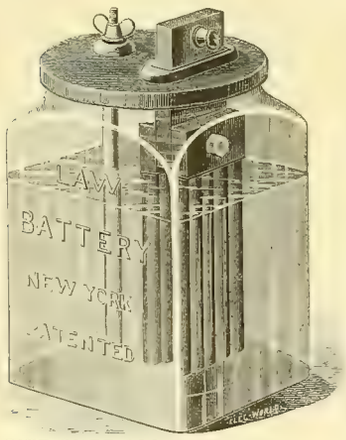
Correspondence Solicited with Electric Light Companies.



W. B. CLEVELAND, Proprietor,

26 S. WATER STREET, CLEVELAND, O.

THE IMPROVED "LAW PRISM" BATTERY



SIZE OVER ALL, 4¼ x 4¼ x 7½.

THE NEATEST OF ALL BATTERIES. THE BEST AND CHEAPEST.

With the exception of glass broken by carelessness, and the zinc and sal-ammoniac consumed in the production of current, **all parts of this Battery are Guaranteed** to be **Everlasting.** Perfectly **uniform** and **reliable** in action, of **faultless construction** and **beautiful appearance.**

PERPETUAL NEGATIVE ELEMENTS!!!

These consisting of specially prepared prisms of Carbon are fine depolarizers, performing this function indefinitely, **do not require renewal**, as is the case where chemical depolarizers are employed, thus a **great economy** is effected. These cells are so constructed as to prevent evaporation of the solution, and crawling out of the salts. Thousands of these cells now employed for **Telephone Transmitters, Gas Lighting, Annunciators, Burglar Alarms** and other **Automatic Devices** are giving **Perfect Satisfaction.**

The many Physicians now using the "**Improved Law**" as an office battery, are unanimous in their expressions as to its perfection and adaptability for electrolysis and general galvanization, requiring no renewal nor attention in from two to five years, the latter depending only on the amount of use.

Note:—This battery is not suitable for Galvano Cautery nor Incandescent Light purposes.

LAW TELEPHONE CO., Sole Manufacturers, 112 LIBERTY ST., NEW YORK.

NEW YORK SAFETY STEAM POWER CO.

BUILDERS OF HIGH GRADE SELF-CONTAINED

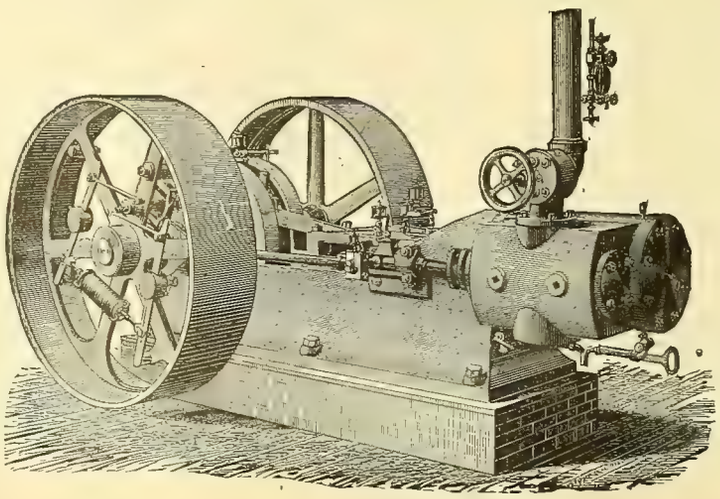
AUTOMATIC

Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC LIGHTS

And other duty requiring close regulation of speed.



ADVANTAGES:

Great strength without excessive weight,
Small space required.
Simplicity of construction.
Accessibility of all parts.

ESTIMATES CHEERFULLY FURNISHED.

Western Office and Warerooms:

64 & 66 S. CANAL ST.,

CHICAGO, ILLS.

WM. A. HAMMETT, Mgr.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS OF

Steam and Hydraulic Machinery.

Complete Steam Plants for Electric Light and Power.

Western Agents for Armington & Sims' Engines, Steel Tubular Boilers, Jarvis' Patent Furnace, National Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Jenkins' Bros. Valves, Etc. Also, Brick and Pipe Work, and Belting.

SEND FOR LATEST CATALOGUE.

707 and 709 MARKET STREET, - ST. LOUIS.

BRANCH, 521 DELAWARE ST., KANSAS CITY.

Holmes, Booth & Haydens,

25 PARK PLACE, NEW YORK.

MANUFACTURERS OF

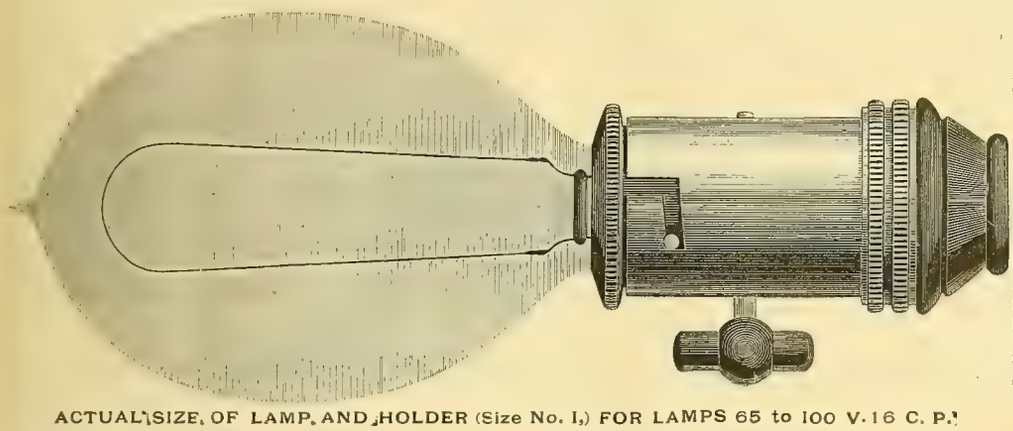
Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

Western Agency, 185 & 187 Dearborn St., Chicago.



ACTUAL SIZE OF LAMP AND HOLDER (Size No. 1,) FOR LAMPS 65 to 100 V. 16 C. P.

Aluminous Incandescent.

We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

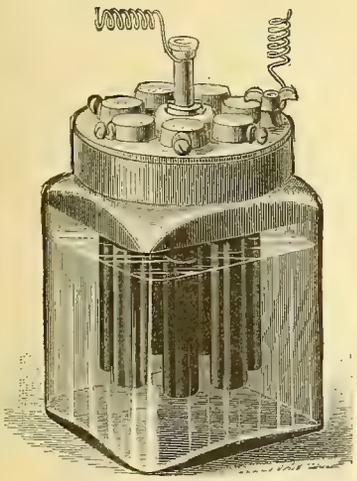
CORRESPONDENCE REQUESTED.
CATALOGUES ON APPLICATION.

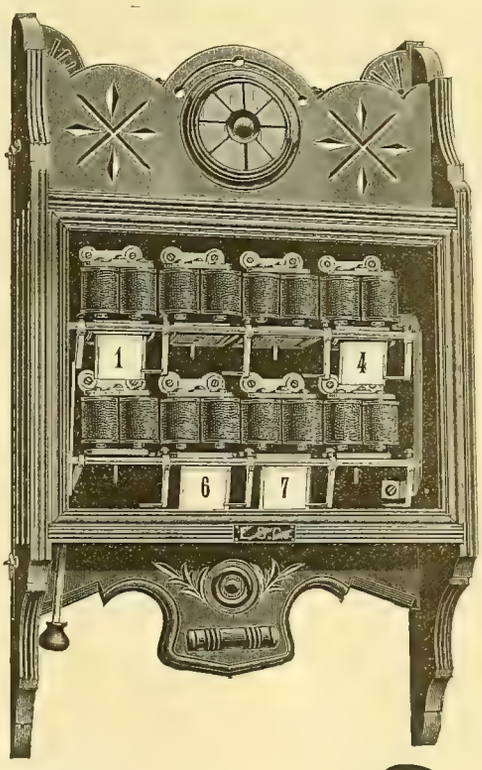
VITRITE & LUMINOID CO., 182 FULTON ST., NEW YORK.

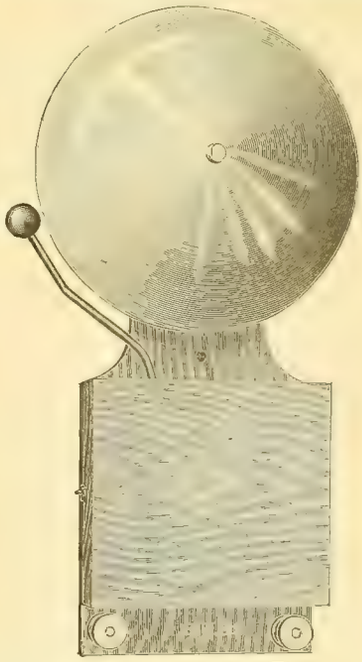
ELECTRIC HOUSE GOODS.

Annunciators, Bells, Batteries, Push Buttons.

A Large Assortment, Thoroughly Well Made.







THE ELECTRICAL SUPPLY CO.,

FACTORIES:
ANSONIA, CONN.

171 Randolph Street, CHICAGO.
17 Dey Street, NEW YORK.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

Telegraph and Telephone Apparatus and Supplies

THE BEST OF EVERYTHING AT BOTTOM PRICES.

DETROIT ELECTRICAL WORKS,

MANUFACTURERS OF

Electric Supplies

INCLUDING

Medical Batteries, Skeleton, Iron and Box Bells, Burglar Alarms, Hotel and House Annunciators, Fire Alarm Boxes, Pins and Brackets, Insulated, Magnet, Telephone and Electric Light Wire.

BUILDERS OF

Fisher's Electric Motors,

AND ALL APPLIANCES FOR CITY AND SUBURBAN

ELECTRIC RAILWAYS.

General Offices and Works, - - DETROIT, MICHIGAN.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, MANAGER WESTERN DEPARTMENT, 216 LA SALLE ST., CHICAGO, ILL.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT,
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously installed by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts.
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348.
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 300 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C. C. Warren Esq.
Dear Sir, I have written the answers opposite your questions above as per your request, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.
Yours truly, J. F. Conklin

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARNER, Manager Western Department, 216 La Salle St., Chicago.

Western Electrician.

EVERY SATURDAY.

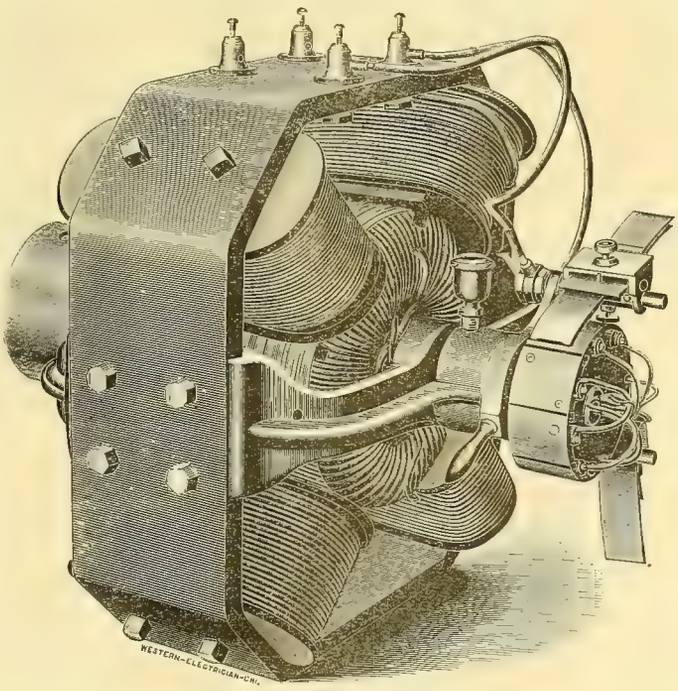
Vol. 1. CHICAGO, OCTOBER 8, 1887. No. 15.

Forée Bain's Electric Motor.

The illustration on this page represents the quadrupolar motor designed and manufactured by Forée Bain of Chicago. The field and armature core are made entirely of wrought iron. The field is quadrupolar with like poles opposite. The novelty consists in the manner in which the armature is wound and connected, and also in the windings and connections of the field magnets. The armature contains eight coils, divided into two groups, the coils of each group being situated quadrilaterally with respect to each other. The current circulates in these groups alternately, and only at a point where the greatest effect is produced. The other group of coils are at this time passing the critical point of the field magnets, and should they remain active—as they would in a Gramme connection—they would partially act to retard the motion of the armature by their relation to the field; so they are cut out of circuit at this point, and their connections are so arranged with relation to one another that, in order to prevent their discharge at the commutator and brushes, they are brought into circuit by themselves in such a manner that the current circulating in the two positive coils of the group is just neutralized or balanced by that in the two negative coils of the group. By this arrangement the idle portion of the armature is removed from circuit without being followed by disastrous results produced by sparking and flashing so common to open circuit motors or generators, and by this connection the internal resistance of the armature is one-fourth that of a bipolar Gramme machine, thus reducing internal work to a minimum, and increasing the efficiency to a maximum.

The manner of producing self regulation is the subject of a patent now pending, and can not be fully described. Suffice it to say that it is neither a shunt nor compound winding, but it is done by a means attended with less loss than either of these methods.

A motor of 5 horse power of this form, 40 amperes and 100 volts, can be put into a box eighteen inches square, and weighs only 260 pounds.



The Electricity of Chemical Reaction.

The following recent experiments by Mr. Enright are interesting and may suggest facts in electro-chemical development which can be turned to practical account in battery construction: The experiments led at first to results of a very baffling and apparently contradictory character. A quadrant electro-meter was connected on one side to earth and on the other to an insulated stand on which was placed a porcelain dish, containing a small quantity of distilled water. Small pieces of potassium or sodium were thrown on the water, and the nature and amount of the charge left on the vessel was noted. This charge was, of course, opposite and equal to that obtained by the escaping hydrogen. With water the observations were inconstant and conflicting, but ultimately two definite and constant results were obtained: (1) Na thrown on strong and pure acetic acid invariably left a positive charge on the insulated dial, the escaping hydrogen being negative; (2) a fragment of zinc thrown into strong HCl invariably left a negative charge on the insulated dial, the escaping hydrogen being positive. The next experiment tends largely to clear up the whole question. We omit the precautions observed and give the result: The porcelain dish was nearly filled with a 10 per cent. solution in distilled water of strong HCl. Three small fragments of granulated zinc were now dropped into the dilute HCl in the insulated dish A very slight effervescence at once appeared. This gradually increased, but never became violent. In four minutes from dropping in the zinc the spot on the scale could be perceived moving, and in four and a half minutes more it moved twenty-eight divisions to the left, indicating the charge on the dish negative and the escaping hydrogen positive. The insulated stand, etc., was now disconnected from the quadrants. The spot maintained its position on the scale. After one and one-half minutes the quadrants were again connected to the insulated stand. The spot moved instantly twenty divisions more to the left. In one and one-half minutes more it had moved ten divisions further to the left, but with a slower pace, and it presently stopped and turned back, at first slowly, taking five minutes to go back the sixty-eight divisions to the zero. In four minutes more it had moved eighty divisions to the right. The insulated stand was once more disconnected from the quadrants, and at the end of two minutes they were reconnected, when the spot instantly bounded up 55 divisions further to the right. It continued to move in the same direction until the effervescence ceased, owing to the acid being exhausted. A quantity of the zinc survived. On short-circuiting the quadrants the spot returned to within four divisions of the original zero. As the reaction between zinc and hydrochloric acid proceeds, the quantity of chloride of zinc in solution continually increases, and so it appears demonstrated that when hydrogen passes through hydrochloric acid it acquires a positive charge, and when it passes through chloride of zinc it acquires a negative charge. "I believe that this inference may safely be very much generalized, but for the present I forbear. In confirmation of it, however, it may be well to mention that at any stage of the last experiment a deflection may be obtained to right or left as required, by adding an excess of saturated chloride of zinc (for the first), or of hydrochloric acid (for the second). When it is known that the sign of the charge on escaping hydrogen depends upon the substance it has been in contact with, the very irregular results with K and Na already mentioned become less mysterious."

Welding and Tempering by Electricity.

Among the patents noted in the last number of the WESTERN ELECTRICIAN was one granted to Elias E. Ries for welding and tempering metals by electricity. The object is to produce welded and tempered joints in steel and other hardened metals, irrespective of shape or purpose to which they may be applied. More especially, however, the invention is intended to provide an improved method of track laying, wherein rail sections may be permanently joined and laid end to end *in situ*, thereby furnishing an almost perfect road-bed, free from rail joints and their attendant evils—chairs, fish plates, and nut-locks—that have always been the fruitful cause of accidents, and have likewise been the chief source of expense for repairs and maintenance of way and rolling stock. By this method, and by means of apparatus forming the subject of other patents still pending before the patent office, the welded portions of the rails are rendered even stronger and tougher than the rest of the rail, so that any amount of pounding or strain can not affect the junction, and the operation of welding and tempering takes place much faster and can be effected at less expense than the laying of the ordinary joints.

To provide for expansion and contraction, a special form of slip joint has been devised, of which there are ordinarily four to the mile. The section of rail between two joints is firmly spiked at its central portion, and expands in both directions. This joint is so arranged as to give a solid support to the wheels while passing, so that practically the entire track is one smooth, continuous way. Whether applied to steam or street railways, this construction will contribute very materially to the comfort of traveling, to the life of the roadway and rolling stock, and to the economy and general superiority of the permanent way.

T. H. McIntosh, a locomotive engineer, in the employ of the Oregon Railway & Navigation company, and W. F. Wamsley, general agent and train dispatcher at Walla Walla, have invented a device designed to do away with the bell cord on passenger trains. All there is of the apparatus is a wire running through the train, a bell in the cab, the battery, and a push button or similar appliance to close the circuit. It is worked on an open circuit, and a battery on the engine supplies the electricity. The wire runs through the hose which operates the air brake, and whenever the hose is connected the wire is connected also.

The Ries Combination Conduit.

Of all the recent applications of electricity now undergoing the process of practical development, there is perhaps none that is at present watched with greater interest, or absorbs a larger share of the public attention, than the employment of this force as a motive power for street railways; nor is there any field in which this most flexible power can be more profitably employed, or in which it promises to produce a more rapid and noteworthy change for the better.

While electricity has been successfully applied on short suburban lines of railway, and is constantly growing in favor and popularity wherever introduced, its adoption for use in large cities, where the demand for safer, cheaper and more rapid transit than that afforded by horse or cable traction is far more urgent, and has up to this time been very backward. This lack of progress has been due chiefly to the want of a practical and reliable underground conduit for carrying the railway supply conductors; one that would not only serve to properly insulate and protect these conductors, thereby securing absolute safety and economy in the transmission of the current, and avoiding any possible interruption in the supply of current to the motor cars, but one that combined with these essential qualities the requisite structural strength to withstand the severe strain and concussion of heavy street traffic.

We illustrate an electric railway conduit that forms the subject of a patent granted recently to Elias E. Ries, of Baltimore, Md., which appears to be admirably adapted to the requirements of electric street railways in large cities. This conduit embodies a number of novel features of practical value and bears evidence of having received sound mechanical treatment in its design and construction. One of the peculiarities of this form of conduit is the provision made for carrying and distributing electric wires, cables and other conductors, the space at both sides of the conduit proper being utilized for this purpose. This, it is needless to say, is a very important advantage in many cases, since it adds but slightly to the first cost of the conduit and obviates the necessity for constructing a more expensive and perhaps less reliable and convenient conduit for this class of service.

In the accompanying illustrations, Fig. 1 is a perspective view of the conduit, partially exposed to show the construction and arrangement. Fig. 2 is a form of bracket for a double track railway, cast in a single piece, and having flanged openings for the reception of wire ducts, pneumatic tubes, etc. This view also shows the conduit channel with its conductors, and the arrangement of the track and slot rails. Fig. 3 shows an ordinary cable railway conduit provided with electric railway conductors, arranged in such a manner (with respect to the cables and grips) that the conduit may be utilized simultaneously by both systems. This construction is of importance where an electric railway is required to turn into a street already occupied by a cable conduit.

Referring to Fig. 1, it will be seen that the supporting brackets are placed in a shallow trench at intervals of four feet apart, and rest upon cross ties of concrete in order to insure a solid foundation. These brackets have a flanged central spring, 6, forming the conduit channel, and on their upper surface are recesses for the reception of the track and slot rails, respectively, as shown. The track rails are preferably of the girder type, and are self supporting between the brackets, and they are removably secured in place by a locking plate, 16, so as to permit removal without disturbing the conduit structure. The width of the conduit slot, which in this system is half an inch, is regulable by means of the adjustable tie bolts, 7, in the usual manner. The construction is such, however, that no perceptible variation in the width of the slot, or in its distance from the rails, is possible, the entire conduit being as firmly and solidly united as if it were one single piece.

The walls of the conduit opening are provided with undercut recesses that serve to hold insulators, 12, which are secured in place as the construction of the conduit progresses. Within these insulators, the supply conductors, 13, are afterwards inserted, these conductors being perfectly free to expand and contract by reason of the slip joint support thus formed, while at the same time they are sufficiently rigid to bear the pressure of the current-collecting wheels that travel in a horizontal position between the two conductors. The conduit channel is provided with drainage outlets at proper intervals, and the brackets have depending ribs, 17, that serve to deflect any water that may enter the conduit slot and cause it to drop clear of the conductors, 13.

It will be noticed that the conduit brackets are formed with a series of flanged openings, 10, at both sides of the conduit channel. These openings serve as a support for paper tubes or ducts, that are prepared in a special manner and impregnated with asphaltum to render them moisture and gas proof. These tubes extend from the center of one bracket to the center of the next so as to form practically continuous tubes, and are hermetically sealed with liquid asphalt poured around a joint of special construction formed upon their ends. When the tubes between two or more brackets are in place the space between the brackets and around the conduit channel is filled with a suitable cement or concrete, which securely embeds and protects the tubes and serves as a support for the paving blocks, thus making not only an economical and permanent conduit structure, but forming a smooth, solid and durable road-bed and street surface. At intervals of one or two blocks manholes are provided for gaining access to the ducts or tubes, and for making connection between the conductors or wires carried in the main conduit and those of branch or distributing conduits at street intersections The interior of the paper ducts is perfectly smooth, and the additional expense for providing and laying them is comparatively slight, so that in localities where the burying of overhead wires is receiving consideration, this class of conduit undoubtedly presents numerous advantages, inasmuch as the rental that can be derived from the use of those ducts will probably far more than pay the interest on the entire equipment.

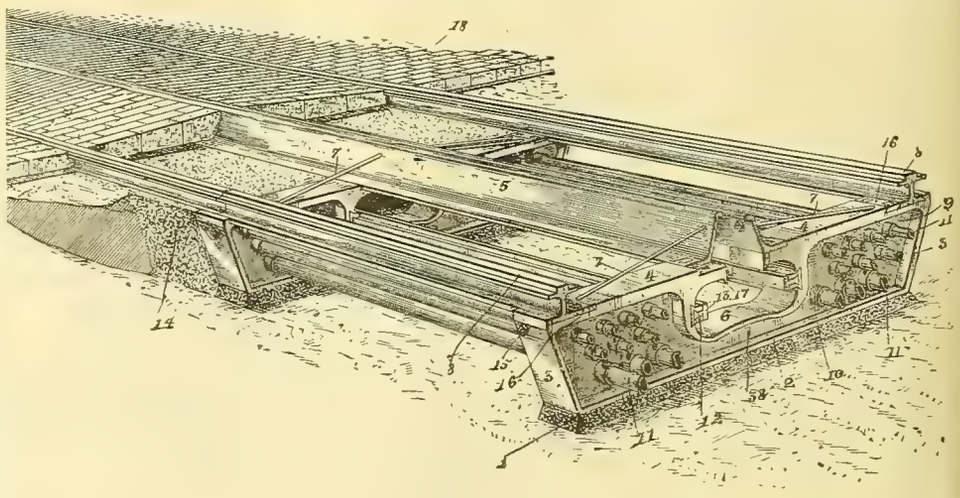


Fig. 1.—Ries Combination Conduit.

Owing to the novel form of current collectors employed in the Ries electric railway system, which we hope to describe at further length in a subsequent article, the depth of conduit channel necessary is but six inches, and the entire depth of conduit shown in Fig. 1 and 2, measured from the street surface, does not exceed eighteen inches, thereby saving the expense and obviating the various underground obstructions common to deeper excavation.

It will be apparent that the wire ducts are not essential to the conduit, but may be omitted in localities where they are not required without interfering with the general construction shown. It is perhaps worthy of mention that two of the twenty-three claims obtained on this patent practically secure to the Ries system a monopoly of the operation of both electric and cable railways from the same conduit, and also the conversion of a cable into an electric railway, a change that by means of this system is rendered entirely feasible, and one that will doubtless sooner or later be made.

Mr. Ries, it is understood, has devised a number of conduits differing in many respects from those forming the subject of the present article, which are specially adapted to the requirements of different localities and systems of operating. The form of conduit illustrated in Fig. 1 is known as "the Ries combination conduit No. 3," and a special feature of all these conduits is that they are interchangeable, that is to say, the distance between the supply conductors and their depth below the street surface is the same in all cases, thus permitting motors of one railway to run with equal facility onto another line provided with a different class of conduit.

Why Electric Light Companies Should Distribute and Sell Power.[1]

By J. L. Barclay.

At a meeting of the National Electric Light association held in Philadelphia last February, the president, Mr. Morrison, in the discussion of a paper on "transmission of power by electricity," summarized a number of questions in the following: "What part of the motor business can electric light companies take at a profit, and, having a surplus power, can that power be utilized at a profit to arc light companies?" There he stopped; I would have added, "incandescent companies." I will try to show in this paper that they unquestionably can utilize their surplus power at a profit — in the first class of electric light companies by a small outlay on their present plant, and in the latter class, incandescent companies, by little or no additional outlay. May I be permitted to say, that I think it is demonstrated now, almost beyond doubt, that there is at present only one economical and safe method of distributing power, and that is by means of constant potential circuits and low electromotive force carried into the users' premises.

I recall how a personal friend in New York came within an ace of losing his life on that "kind of fellow who takes so little copper to distribute and admits of using our present arc or constant current machines." Another in my mind is our friend who attended the first dinner of this club and three days afterwards was killed. Another in Detroit: A young lady working on a sewing machine, suddenly fell back in her chair and was carried home. She lay three days between life and death, and at last recovered. Gentlemen, what caused it? It was the current from the motor supplied by that "kind of fellow who takes so little copper to distribute and admits of using our present arc or constant current machines." If she had died, it would have been heart disease that killed her; fortunately she lived to tell what struck her. This is not, I am sure, what you, who know the dangers of such currents and sometimes get caught, wish to place in the hands of men and boys who are ignorant of its danger. Do not say, "we can protect and fence in motors of that class," for some one has to go near them at times, and from my observation motors are placed in the most favorable points for accidents to occur — oftentimes in damp basements and other out-of-the-way places.

In conversation, those who are operating con-

1 Read before the Chicago Electric Club, October 3d, 1887.

stant current motors have stated that the energy used does not vary with the load, as is the case in constant potential motors. The manager of a large arc light company who has 30 horse power of motors running from constant current circuits, stated to me a few days ago that he was satisfied by tests made, that it takes as much power to run a 14 horse power constant current motor when doing say 8 horse power work, as when doing its maximum, notwithstanding the statement made by his parent company to the effect that the automatic governor enabled the motor in such cases to use only the proportionate amount of energy to develop the work done at any one instant. Now you say, admitting what I say to be true, what have we to expend and what will we earn?

Permit me to illustrate the position of many arc light companies, aye, it will apply to incandescent companies too. You have a valuable franchise, a franchise, which, when you first installed your plant, was considered exclusive, but, some how or other, the other man's light managed to work in and get a franchise also. What is your position? Both companies are selling light at a price one-half you otherwise would, or possibly, you have a hard time to pay expenses because the gas company has lately bought a small plant and is offering lights at $5 per month; or you are operating a plant where you are not well patronized, and where you did not find, as you expected—babies crying for it; but there is your investment and you have got to devise means to make it pay. You have your poles erected throughout the town, you have your organization, engines, boilers, etc.; you stand in a position in which you can utilize the capital already invested and make it pay. Has it ever occurred to you that you are asked to employ your machinery less hours per day than in any other business, and yet you hope to make as much money? Even your gas friends employ their plant more or less hours out of the twenty-four, for they make gas during the day for use at night, which, at the present time, even with embryo storage batteries, electric light companies are prohibited from doing. It seems to me pretty much like taking a man's dollar and saying, I will take your dollar and call it fifty cents, and earn as much on it in electrical business, using it but a few hours per day, as a dollar can earn in any other manufacturing business in twelve to twenty-four hours per day.

Now, assuming you have a fifty horse power steam plant lying idle during the day. The cost of installing constant potential generators and wires for distributing the power would not exceed $5,000, and the revenue in the shape of rental that you would get for that distributed power at say $75 or $125 per horse power, per year, would be from $6,500 to $7,500 per year. The cost to you to deliver this power would not exceed $3,500 a year; that is allowing more for an engineer than I see by one of the electrical papers is allowed to an engineer of an electric light station in eastern Pennsylvania, who operates a 120 horse power plant and receives the munificent salary of $600 per year. Bear in mind that practice has clearly proven that twice the amount of delivered power can be safely contracted for and sold to the consumer; that is, of course, on distributed work, not if sold in one unit. As you are all familiar with the profits from light, it will not be necessary for me to give you figures for comparison.

Taking another instance: Assuming you have a 100 horse power steam plant lying idle during the day, the outlay for constant potential generators and wires for distributing the power would not exceed $8,000 and the revenue on the same basis as on the first is from $12,000 to $14,000 per year and at an expense not exceeding $6,000. Bear in mind, as I stated before, that you can safely contract for double the amount of power delivered at the motors.

Now taking the cost to an incandescent light company, they would not have to expend one dollar. They have their generators and steam plant, the wires, their organization, franchise, etc., all present and have but to make an intelligent canvass to find what power they can dispose of; but some of you will say, we can find only one or two men in our town who need power at present, as the others are all supplied with steam and gas engines; and there you stop and drop the subject. Well, all I can say is this: If you were so easily knocked out when you made your canvass for arc and incandescent light customers, you never would have had occasion to get up steam in your boilers.

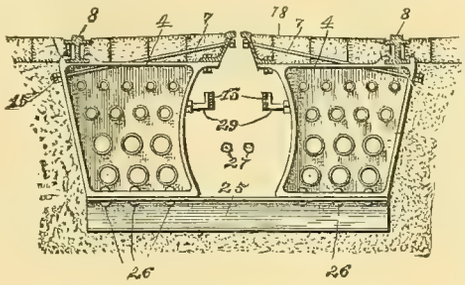


Fig. 3.—Ries Combination Conduit.

In my travels from one part of the country to the other, I have always heard the electric light manager spoken of as a "hustler" a "fighter," and as the president of a gas company said to me not long since, "their managers and superintendents have as much gall as the line men they employ." Possibly he had had a pole erected in front of his door. Whether he meant that appellation as a business compliment, I do not know, but I take it, it was meant as such, having experienced some of it especially when reels, copper, 6 months' time, was the subject of conversation.

How, you ask, would I get a revenue in such a case? I would go to three or four consumers of power, parties who would use 50 actual horse power in all, and ask permission to place a motor in their premises to drive their machinery, they to pay me for the power only, with the understanding that after using it, say, two months' time, I would remove it if they did not wish to rent or purchase the motor. That motor never comes out. It is like street car accommodation in large cities. The oftener the cars are running the more people get in the habit of using them. The user of the motor is so pleased with the ease with which he can start up his machinery—the mere turning of the switch. His workmen like it. They state they never had such uniform power before. Then each time the electric light manager takes some probable customer or fellow-townsman into his premises to see the motor work, he tells of its good points so often, that after a time he becomes enthusiastic on the subject of electric power, and does not rest until his fellow-townsman gets a motor. At the expiration of the two months, he pays for the motor like a man, advertises his engine for sale and gives the electric light company a testimonial something like this: "The 15 horse power motor you installed in my premises two months ago is the best and steadiest power we ever had. It does the work of a 30 horse power engine and gives absolutely no trouble whatever," etc.

Now, gentlemen, you must show your faith and confidence in the motors before you can expect people, knowing nothing of electric machinery, to invest their money, and you can best do it by taking the method I suggest. After your customer has had it in his premises a month or so and sees how well it works, how little trouble, how little wear and tear, he will have confidence to purchase. After you have a few placed it is easy sailing.

I happened to see some figures last Saturday of two electric light stations that make a business of selling power. One was in a town of 25,000 inhabitants, situated 300 miles west of Chicago. The figures were as follows: They have 103 horse power in motors installed. The actual amount of horse power they contract to deliver is 32. The maximum amount of steam power they have been called upon to supply is 40 horse power. The revenue they receive is $7,600 per year, and they figure that the cost to supply that does not exceed $3,000 per year, showing a clear gain of $4,600.

Another company is situated in a town east of Chicago. They have some 270 horse power in motors installed and a revenue of nearly $16,000 per year. As to what it costs them to get that revenue, although I have it only by hearsay, my authority is good for saying it does not cost them over $6,000 a year.

These figures speak for themselves. They are from practice, and not from theoretical figures given by some manufacturer of machinery. They started in the power business, as I have proposed to you to-night. I would call your attention to the fact that both these stations supplied current from constant potential circuits and I have not heard of any station in the United States where they can make the same showing from constant current motors.

Another station I know of has a revenue sufficient to pay its entire coal bill for light and power, and that station operates between 6,000 and 7,000 incandescent lights. Still another has 75 horse power installed, and the maximum amount of steam power they have ever been called upon to supply has been 40 horse power. Thus you see, to get a revenue and a good one from your plant, night and day, you should go outside of your present field of lighting, and not throw the heavy burden on your lighting business by employing your capital such a short time each day and expect to pay large dividends.

Another source of profit to the electric light manager, in addition to the supply of stationary power, is the supplying of power to operate street railways. I am sure the horse railway men would only be too glad to have the assistance in the matter of advice from any one who understands something of electrical matters, and if you should induce them to operate their cars by electric propulsion, and if you get from $1.50 to $2.50 per day, per car, you would find this quite a profit in addition to your present receipts. Thus, you see, it is within your reach in many ways to keep your machinery employed more or less hours out of the twenty-four.

If you have resolved to start in the motor business, do not be content with only two or three motors on your circuits, but get a number, and you will find you can often sell power at the same figure it costs you to produce, and make a profit by reason of intermittent use. How much more profit then is there when you can sell it from $75 to $125 per horse power, according to the amount rented.

I do not say you can by reason of intermittent use get, as some electric light systems that have been heard of but never seen in practice, twenty sixteen-candle power lamps, or four 2,000-candle power arcs to the horse power, but I do say you can rent on distributed work and receive a revenue from twice the amout of power you generate. If my statement is wrong, then practice is wrong also.

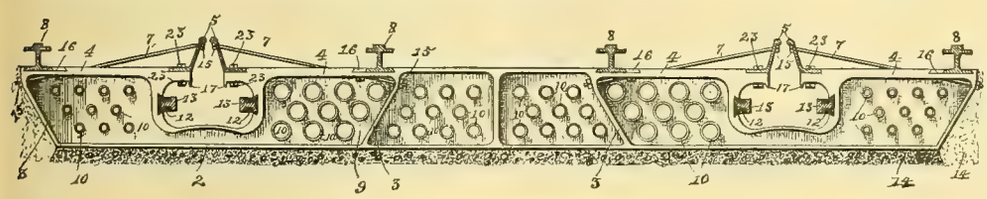


Fig. 2.—Ries Combination Conduit.

An Electric Target.

Interesting trials have recently been made at the arsenal at Washington of the Ullman electric annunciator target. It is a time and money saving device for rifle practice. The target can be made for rifles of any caliber and range, and the value and location of each shot striking it is accurately registered on the annunciator, which is located at the firing stand and connected by seven wires with the target.

Its face conforms in every respect to regulation targets. The target is made of a solid metal plate or of solid rings, or with the latter divided into segments. They are rigidly secured by bolts to a thick oaken base plate, through

which pass a number of metal pins held in place by spiral springs. To another plate is attached a corresponding number of properly adjusted pendulums, each resting against one end of a pin, the other end of which pin is against the back of the target plate. Electrical contacts are made by the motion communicated to these pendulums through these pins by the force of the bullet in striking.

The dial of the annunciator is a fac-simile of the target, having thirteen small openings corresponding to the bull's eye and twelve line shots. When a circuit through the magnets of the annunciator is completed by electric contacts at the target, a number or combination of numbers, indicating the value and location of the shot, is instantly exposed, by which combination the target is practically divided into thirty-three sections.

The device is simple in construction and operation, both mechanically and electrically, and by its use the marker's service with its consequent danger is dispensed with; the delay incident to the ordinary methods of "marking" is obviated, and dispute is impossible. A few short-range targets of this patent have been in use for several months, and one of two hundred yards range has been thoroughly tested at the Washington barracks range with an entirely satisfactory result.

Irish's Electro-Thermal Recording Telephone.

In this apparatus the change of condition of certain metals during the passage of electricity through them is taken advantage of for recording sound signs and reproducing sounds. As is well known, a fine platinum or other wire may be made incandescent or red hot by passing through it an electric current, when the wire is of higher resistance than any other portion of the circuit; also that on increasing the resistance of such a circuit the wire will instantly lose heat in proportion to the amount of resistance introduced into the circuit, and further, that when the circuit is broken the wire will quickly fall to the temperature of its surroundings. It is also well known that certain metals contract more or less in proportion to the amount of current passing through them and the rise and fall of temperature due to the flow of such current. Therefore it is easy to conceive that the result of passing a ribbon of any material which is more or less affected by heat, such as tin foil insulated with a thin coating of varnish, across a pointed loop of platinum maintained at a very high temperature, will be to destroy or burn away the ribbon at the point of contact only, and that such ribbon will be more or less destroyed at the point of contact according to the heat and form of the loop and its force and pressure against the ribbon. A simple apparatus devised for the employment of these effects in the transmission, reproduction, and recording of articulate and other sounds is illustrated and described. In the center at the back of an adjustable diaphragm shown in Fig. 1, rests a wedge-shaped piece of platinum wire supported by two springs and resting with the thick end of the wedge against the center of the diaphragm, while the point is directed inwards and lightly touches the ribbon in which the message is to be perforated. The ribbon behind the point passes over a drum which is recessed circumferentially in its center so as to offer no obstruction to the passage through the ribbon of the heated platinum point. This platinum point perforates the ribbon more or less according to its degree of heat, its shape and size, and the intensity of the sounds actuating the diaphragm. The louder or higher the pitch of the sound the deeper will be the penetration of the platinum point through the ribbon and the larger in proportion will be the perforations. The perforated ribbon as it leaves the recessed drum is drawn between two other drums connected respectively to the line and to one pole of the battery employed for transmitting; the other pole of battery being to ground as shown by tracing Fig. 2. The transmitting, or two last mentioned drums, are encircled by an elastic non-conducting material made adhesive on the outer surface to hold the carbon powder with which they are served. The inventor sometimes employs with advantage, in lieu of the elastic carbon covered rollers, a vessel or funnel containing carbon granules. This funnel takes the position of the uppermost roller, and a flat conducting plate, supported below the orifice in the bottom of the funnel, serves the purpose of the second roller, space being left sufficient to allow the perforated ribbon to travel freely between them. When the ribbon is drawn between the funnel and plate the carbon granules fall from the funnel into the perforations and make contact with the bottom plate. It will be understood from the above that as the perforations in the insulated ribbons vary in size, so in proportion will more or less carbon fall into them and the resistance of the circuit be varied. The larger the perforation the greater the space which will be occupied by the granules and the lower the resistance of the circuit and, as must necessarily follow, the smaller the perforations, the less the space for the granules and the greater the resistance of the circuit. Preference, however, is given to the two elastic conducting drums, as illustrated, over the funnel and carbon granules for transmitting. These drums make contact with each other through the perforations only, and so vary the resistance of the circuit accordingly. The interruptions and variations in the resistance of the circuit caused by the passage of the perforated ribbon between these contacts are made to reproduce on a receiving instrument at the distant end of the line the same sounds which

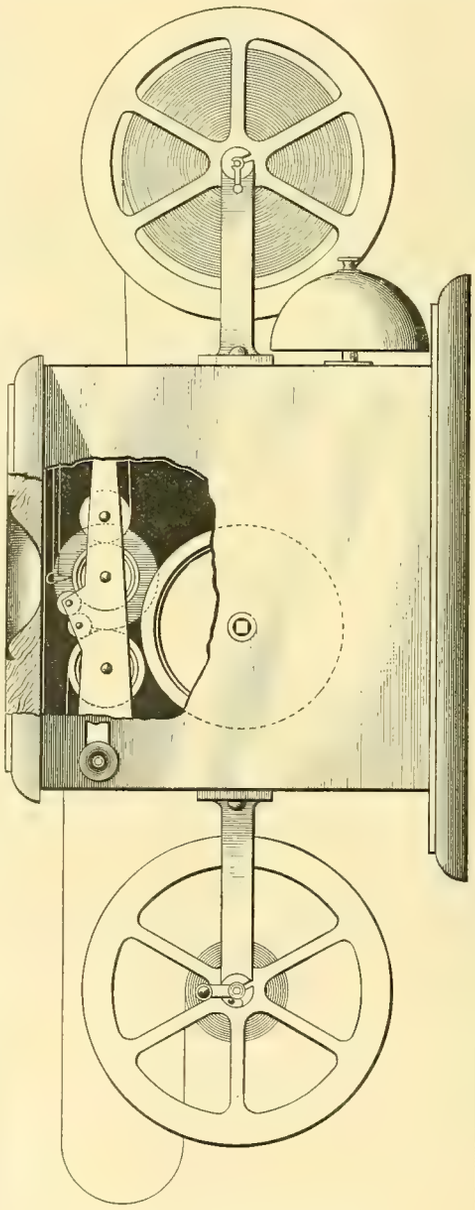


Fig. 1.—Irish's Recording Telephone.

actuated the diaphragm and perforated the ribbon at the transmitting end. The system possesses the advantage of making a permanent record of all messages transmitted, and in such a manner that the messages may be again transmitted at any subsequent time by simply passing the ribbon between the contacts, or for local articulation or reproduction between the cold platinum point and recessed drum. In either case the perforated ribbon is drawn between the platinum point and recessed drum by the clock-

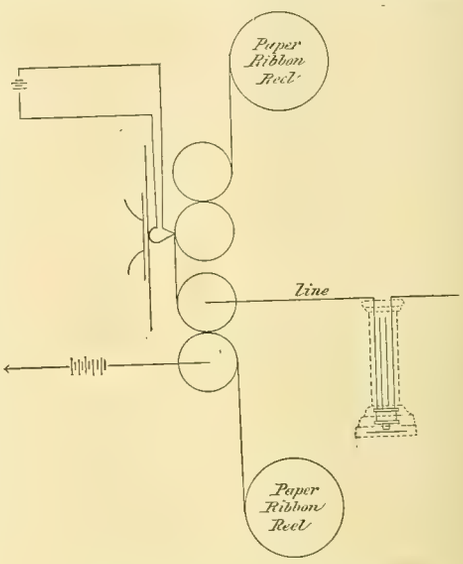


Fig. 2.—Irish's Recording Telephone.

work as when used while speaking, the ribbon being first wound back off the lower on the upper reel. When the message to be reproduced is on a filed ribbon, the ribbon is placed in the upper reel and wound off on an empty one placed below. Thus these instruments act as transmitters and reproducers of all messages previously sent on them. It will be seen that a local circuit is employed for heating the platinum while transmitting, but not for the receiving or reproduction or retransmission of a message.

The receiver most generally used in connection with this transmitter is not as illustrated, but consists of a similar tube with enlarged end for diaphragm and ear piece outwardly like the Bell receiver, but here the similarity ends. A wire is stretched several times between the bottom of the receiver case and the diaphragm, each wire as doubled back being insulated from the next in such manner as to cause the currents to travel each bend and the whole length of wire. The two ends of this wire are connected as usual to binding posts to which also the line and ground wires are connected. The variations in the resistance and the interruption of the circuit caused by the difference of size or degree of the perforations, or their absence, cause the wire stretched in the receiver tube to expand and contract, correspondingly vibrating the diaphragm and reproducing the sounds given out at the distant end of the line.

In this system of telephony, magnets and electro-magnets as employed by the Bell and other companies can be dispensed with, as well as carbon transmitters with diaphragms and tension regulators such as are employed by them and other companies.

The transmitting part of this apparatus can be employed and gives excellent results as a phonograph. For such a purpose it is found advantageous to employ a somewhat stiffer style than the platinum one referred to for perforating the ribbon. The ribbon employed may be of especially prepared paper or metal foil well insulated.

This instrument makes sound vibrations visible and reproduces a permanent record of them, which can be stereotyped and used to print from. It not only makes speech visible, but reproduces it in such quality of tone and clearness that persons acquainted with the speakers can recognize their voices.

Liquid Electricity.

New Jersey, far famed for "liquid lightning" of a tangible and potable form, is responsible for the following "liquid electricity" yarn:

"It is said that the Keely motor is likely to have a powerful rival before long in the alleged discovery of what may be called 'liquid electricity' by an Englishman named Maxwell. The inventor has formed a twenty-year co-partnership with a New Jersey capitalist, who owns works at Passaic. It is proposed to manufacture the fluid

by the gallon, and it is asserted that four cents' worth, placed in a vessel, will run a sixteen-candle power incandescent light ten hours. It is also alleged that power sufficient to run a steam launch or a tricycle can be readily developed. The fluid is averred to be the result of chemical combinations and processes never before discovered and impossible to analyze. The secret of the composition has been written out and locked up in a New York safe deposit vault. In case of the death of Maxwell within the period of the partnership the secret becomes the property of his partner. It is said that a public exhibition of the alleged power will be given in Passaic shortly."

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number XII.

The Thomson-Houston Dynamo Continued.—Sparking at the brushes is the result primarily of the passage of electricity through the air, as the brushes change from segment to segment of the commutator during its rotation, and are, for the moment, out of electric connection, all dynamos being more or less subject to it. The heat developed at the commutator by friction and electric action rarifies the air, and hence reduces its resistance and increases the liability to sparking. Hence, a constant, strong current of cool air, such as is supplied by this air blast, increases the resistance, and, as the result shows, renders it too great for the passage of the spark. With the air blast oil can be freely used to reduce wear on the brushes, without affecting the insulation.

The common theory that the spark may be "blown out" in the same sense as a light is extinguished in ordinary combustion does not seem to be tenable, though apparently sanctioned by as good authority as that of Professor Silvanus P. Thompson. In ordinary combustion the blast removes the burning gas, and combustion ceases. But this has no similarity to the present case. The arc light between two carbons may also be blown out, and is more nearly a parallel case, but in the arc an electric current is first established by contact of the carbons, and subsequently maintained after their separation, by the conductivity of the burning arc; the cool blast extinguishes the arc both by removing the burning gas, produced by combustion, and increasing the resistance, and there must be a contact of the carbons to re-establish the current before it can be lighted again, whereas in sparking at the brushes there is no combustion.

The lightning arrester, used to protect the dynamo against damage by lightning, is also an important adjunct. It is shown in Fig. 34, and is constructed with an electro-magnet, through the coils of which the current between the lamp

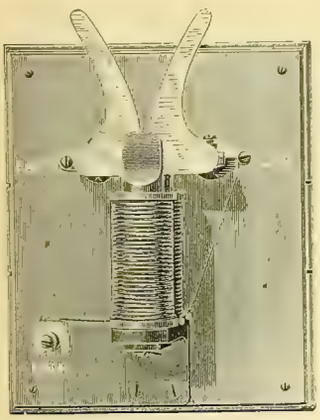


Fig. 34.

circuit and dynamo passes. The two magnet cores project vertically above the coils, as shown, and between them are placed, edge to edge, two projecting wings of brass, their broad bases about one-fourth of an inch apart, and their narrow upper parts receding from each other, as shown. The instrument is mounted on a wooden base, screwed to the wall, and the wings are out of contact with the magnet cores, each one screwed to a brass lug, one of which is connected with a line leading to the lamp circuit, and the other with a number 4 copper wire leading to the earth, as indicated. The line from the dynamo circulates round the magnets, and is also connected to the upper right-hand lug. The lamp circuit line has thus two branches from this lug, one through the magnet to the dynamo, and the other through the brass wings to the earth; the latter interrupted by the narrow, quarter inch air space at the base of the wings. This air space is sufficient to insulate the left wing from the dynamo current; but if a discharge of lightning occurs on the line, its great intensity causes it to leap the air space and take the shortest course to the earth; the projecting edges of the wings facilitating the discharge, though not sharp enough to short-circuit the dynamo current. Part of the discharge must go to the dynamo, dividing between the two branches in proportion to the relative resistance of each, but the distribution of this portion in the mass of the machine prevents injurious results.

The object of the projecting magnetic poles, between which the wings are placed, is to extinguish the spark during the passage of the discharge from wing to wing, by establishing a magnetic current at right angles to the line of discharge.

Fig. 35 shows the relative positions and connections of the various parts of the system; two arresters, one in each branch of the circuit being recommended as shown.

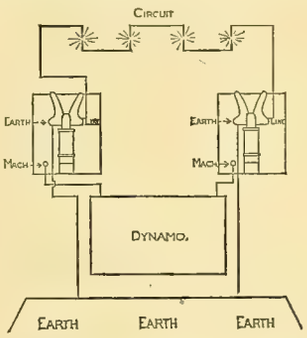


Fig. 35.

Various kinds of arresters are used in connection with different systems of electric lighting, in some of which combs with projecting teeth take the place of the wings, in others a soft metal connection is melted, while in others a mechanical device, operated electrically, severs connection with the machine. These arresters are also applicable to telegraph and telephone systems, and are applied in a similar manner.

The Western Electric Dynamo.—This dynamo, made by the Western Electric company, is noticeable chiefly for the structure of its armature, in which insulation, ventilation and method of winding are the prominent points. It is of the drum type; the core is supported on the shaft by an open frame work of brass, which consists of three spiders, one at each end, and one at the center; to which are attached three lug rings, each having thirty-two projecting wedge-shaped lugs, between which the coils are wound. To these rings four longitudinal bars are attached on the inside, one between each two arms of the spider, and insulated from the rings by asbestos. On these bars, but insulated from them by asbestos, are mounted thin sheet-iron rings of the pattern already described. These are grouped together in sets of twenty, each set being insulated from the adjoining set by strips of asbestos coated with shellac, leaving open spaces for air circulation. Bands of canvas ⅜ of an inch wide, placed half an inch apart, insulate the core from the coils, leaving air spaces between them; and at each end are thick rings of asbestos.

The coils are wound longitudinally with number 13 insulated copper wire, in one closed circuit, after the Gramme type, between the lugs but insulated from them. Each coil when wound, stretching along one side of the core lengthways, fills each of the three spaces between three pairs of lugs in line; then, passing over the end, it divides into two equal parts, and the two halves return on the opposite side through two rows of lug spaces, with an empty row between. This empty row is then filled by another coil in the same manner as the first row, and the two halves passing over the end as before, return on each side of the first full row. The two coils thus fill three rows of spaces on opposite sides of the core, a full row being between two half-filled rows. Two more coils are then wound in a similar manner at right angles to the first two; and when half the wire is thus wound, the winding is completed with the other half; each half-filled space receiving another half, and each empty space being filled. The sixteen coils being then properly connected in one closed circuit, are attached to the sixteen segments of the commutator. By this method of winding, a half coil section always precedes a full coil section, and another half follows it as the armature rotates in the magnetic field; so that the magnetic effect on the coils rises and falls gradually, and sudden fluctuations of current and consequent sparking at the brushes is reduced.

The interior of the armature being hollow, communicates with the external air by passages through and around the core and between the coils, as described, giving thorough interior ventilation, and reducing the heat accumulation to its minimum.

The commutator segments, made of bronze, and separated by air spaces, are screwed to interior segments of brass, mounted on an insulating cylinder of hard maple, inclosing a brass cylinder attached to the shaft. The automatic rotary movement of the brushes on the commutator, by which the current strength is varied, is also adopted in this machine.

Two field-magnets of the horse-shoe pattern, placed horizontally, form the magnetic field; their opposite poles, facing each other, are joined together by two central pole-pieces, each cast in one piece with the two connecting cores, forming consequent poles, inclosing a circular space in which the armature revolves; the sectional area of the magnet cores practically equaling that of the armature core, so as to insure magnetic saturation. Number 5½ to 6 insulated copper wire is used to wind the magnets; the layers being separated in three places by the insertion of wooden slips for ventilation.

This dynamo has also a lightning arrester, which consists of three rectangular binding posts, mounted on the center of the pole-pieces, on a hard rubber base; the middle one insulated from the two outer ones by eighth-inch air spaces. The outer posts connect the field-magnet coils with the line, while the central post is connected with the earth. Lightning on the line, to or from the earth, crosses the narrow air spaces, and the dynamo escapes harm; while the ordinary current is insulated from the earth connection by the air spaces.

Experiments in Electricity.

Experiments are being made at Cap de la Hève, near the mouth of the Seine, on the production of electricity for lighthouse purposes by means of the force obtained by windmills. The suggestion to do so was made by the Duc de Feltre, and it is a system proposed by him that is to be tested. The wind works a dynamo machine employed in charging accumulators of suitable capacity. The electricity so produced and stored is to be used at will to make a focus of light. The system, if successful, will have the advantage of costing only the putting up of the machinery. The whole question to be ascertained is whether a sufficient quantity of electricity can be stored to provide for the requirements of any particular station when there is no wind to move the sails of the mill. M. de l'Angle-Beaumanoir, a civil engineer at Paris, has been authorized by the Minister of Public Works to make, at the expense of that department, the trial of this system of electric lighting at the La Hève lighthouse.

Consul Jernigan, at Osako and Hiogo, Japan, in a report to the secretary of state upon railroads and railway regulations in Japan, states that no less than thirty-four new railway projects have been started within the last six months, twenty-one of which involve an aggregate capital of $48,000,000. The existing roads have all been surveyed and constructed by foreigners, but the list contains the names of no Americans, nor do American mechanics or engineers appear to have any connection with the new projects.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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THE subject of imposing a license on telephones in Chicago has again been taken up by a committee of the city council. No specific move has been made, however.

IT is stated that C. A. Parsons, of Gateshead, Eng., has succeeded in constructing an engine driven by steam, which, it is said, with a very moderate consumption of coal, makes 10,000 revolutions a minute, and can work up to a speed of 30,000 revolutions.

AGAIN it is announced that the Western Union Telegraph company is about to absorb the Baltimore and Ohio company. President Garrett is on his way home from Europe and this unlooked-for move has been interpreted to mean that he is desired in this country to sign important papers relative to the transfer of the property of the latter company to the former.

MONTGOMERY, Ala., has a plant that furnishes an electric current for the propulsion of street cars, that furnishes a current to run motors for small powers and that furnishes a current for lighting the lines of the street railway and the vicinity.

Here is an investment in a plant that furnishes at a minimum cost both light and power; heat could also be furnished from the same station.

Can this investment be paralleled in any other branch of industry?

THE phonotograph or recording telephone, which we describe elsewhere is a new invention whose usefulness will be appreciated, provided it does not complicate the existing difficulties of telephone transmission, or increase the expense. If a telephone message can be recorded, so that it can be reproduced, either vocally or graphically, and its identity and validity verified, it will add greatly to its value in many cases in business and legal transactions.

AND now by an invention of an electrician it is proposed to lay practically continuous rails for railroad or street railway tracks, the joints between the ends of the rails being welded and tempered. The matter is treated briefly in another column.

The step from patent office drawings to practical operation is frequently a long one and too often involves a heavy outlay of money in experiments. But the plan seems practicable and the way is indicated for a great improvement on the present methods of track laying.

M. FARADAY, in a published communication, believes that a lightning conductor should be of half-inch copper rod, and should rise above the top of the chimney by a quantity equal to the width of the chimney at the top. The lengths of rod should be well joined metallically to each other, and this is perhaps best done by screwing the ends into a copper socket. The connection at the bottom should be good; if there are any pump pipes at hand going into a well they would be useful in that respect. As respects electrical conduction, no advantage is gained by expanding the rod horizontally into a strap or tube—surface does nothing; the solid section is an essential element.

IT is evident from recent experiments with the new dynamite gun that if naval warfare is to continue as a necessity of modern civilization, this gigantic bomb thrower with its compressed air and electric fuse will make short work of it. When a combatant finds himself in range of the enemy's guns, he may as well hoist the white flag at once to escape instant annihilation; or if both combatants fire at the same instant no one will be left to tell the tale.

The air gun is about sixty feet long and the bomb, containing an explosive charge of fifty-five pounds, inclosed in a brass case, is thrown one to three miles with great accuracy. These guns, on account of their extreme length, are mounted in the bow and stern only, while ordinary guns are mounted at the sides, though it is not clear what use can be made of the latter if half the advantages claimed for the dynamite gun are realized.

THE tables of statistics presented at the telephone convention, and published last week, give a very clear exhibit of the present condition of the business, and the progress made during the past six years; the progress during the past year especially is highly encouraging, and the past two years show a marked increase over previous years.

But the report, as a whole, is very far from being confined to mere statistics and business detail. It embodies papers of the highest scientific interest, giving the results of past experience, the changes in material used, in the character of instruments, and the methods of installation, in an exhaustive manner. The nature and value of insulation employed, and the improvements required, both in the style of the insulators and the material, received close attention. Numerous changes have been made, and methods and theories once popular have been reversed. This has been especially true in regard to long distance telephony, which is still largely in the experimental stage. The use of copper in preference to all other conductors, of complete metallic circuits so far as practicable, and of the very best insulation, are among the leading improvements which are being adopted.

THE paper on underground lines presented at the telephone convention last week by W. E. Sargent, of Brooklyn, embodying a report on Chicago underground and aerial lines, by B. E. Sunny, is of the highest practical interest, giving the results of numerous experiments in different cities with different underground cables and conduits. It is apparent from this report, that while numerous tests and costly experiments have been made, and much valuable experience gained, underground work is still in an unsatisfactory condition, and that the length of underground lines is limited.

In regard to insulation the various tests and experiments seem to show, that, while good insulation is an absolute necessity, extremely high insulation, either on underground or aerial lines, is impracticable; that one to five megohms per mile gives good practical results, while 300 to 800 megohms cannot be maintained, and is of no practical utility.

The fault of cross talk has received a great deal of attention, but the degree of progress in its reduction has been comparatively small; and it is very evident that much still remains to be done before it can be even materially reduced, while its eradication is a work of the future.

Mr. Lockwood's paper giving a history of the telephone and telephone business for the last ten years, shows that rapid and substantial progress has been made. When we consider the importance of the telephone to-day in facilitating the transaction of business, the improvements in the present methods of transmission, the vast amount of capital invested in it, and the fact that this invention, developed and brought into use in the United States, has found its way into every part of the civilized world, penetrating even into old conservative China, we can hardly realize that it is only ten years old; the first patent having been issued in 1876, the second in 1877, and its first important success achieved at the centennial exposition at Philadelphia, by which its value and utility were demonstrated. And while we willingly accord to Phillip Reis, all the honor to which he may be entitled, as one of the early inventors, we feel a just pride, as Americans, in the fact that our own countrymen, Gray and Bell and Edison, developed it and brought it into actual, practical use.

THE combination conduit, fully described on another page, by which the entire electric system of conductors for telegraphs, telephones, light and power, are combined in one conduit, seems to be admirably adapted to the purposes for which it is designed. Some such system is an absolute necessity in large cities, where the nuisance of a network of overhead wires gives place to an equal nuisance in the constant tearing up of pavements to put them underground. So that it is only a choice of evils. A solid granite pavement is laid with great care, and at great expense, and the road-bed made smooth and compact with heavy steam rollers; and the work is scarcely completed, and the interruption to travel obviated, when channel after channel is cut through it, for gas, telegraph, telephone, electric light, and electric power conduits; and this continues and increases year after year, as new companies and new systems demand accommodation. So that not only is there constant interruption to travel and inconvenience, with the concomitants of mud and dust and offensive smells, but the solid, smooth pavement is soon rendered practically worthless and full of ruts and holes. The condition of our principal streets in Chicago bears ample testimony to the fact that this picture is not over-drawn. Now, let the system described, or some similar system be adopted, which shall furnish ample and permanent accommodation for the various purposes specified, and save the inconvenience and enormous cost of the present wasteful method; and when adopted, let the streets in which it is placed, be protected by law from further interruption for a term of years, or until re-paving is required.

IT is evident from occasional inquiries by correspondents that the character of the electric motor is not generally understood. An electrician, or electric business man does not need to be informed on this point, but when a correspondent asks whether a motor would be cheaper than a steam engine it is evident he quite misapprehends its nature; though such a mistake is very natural, and on a par with similar mistakes in regard to electric transmission by telegraph and telephone.

The motor is not a generator of power, but a transmitter; the steam engine, or the water wheel, is still the original source; but it is often inconvenient or impossible to use the power thus generated, and as in the case of street cars or mining operations it can be converted into electricity by means of a dynamo, transmitted by a wire to a car or the bottom of a mine, and there reconverted into mechanical power by means of an electric motor and applied.

In this transformation there is, with the best arrangement, 15 to 20 per cent. loss; to which must be added the loss from resistance of the conductor, depending on its size and the distance to which the power is conveyed; so that the power actually utilized may not exceed 40 or 50 per cent. of the power generated. Hence it is cheaper to use the power direct from the engine or the water-wheel, when possible, than to transform and transfer by means of electricity.

If the time ever comes when the heat of the furnace can be converted at once into electricity, the engine can then be dispensed with, and the motor take its place; but till that result is achieved steam must remain king, and the engine continue, as it has since the days of Watt, the crowning glory of the mechanical achievements of the century, to whose behests even electricity itself is still subject.

Chicago Electric Club.

At the meeting of the club Monday evening, October 3rd, President Stiles occupied the chair.

Treasurer Terry presented a report showing a satisfactory balance in the treasury, and further that $475 had been subscribed to furnish the new club rooms. This amount was increased to about $550 before the close of the meeting.

Secretary Kreidler reported that twenty-three applications for membership had been received since the previous meeting.

W. J. Buckley, for the committee on new and permanent quarters, reported that rooms had been engaged on the second floor over 122 and 124 Clark street. The location is particularly desirable. It is down town, and convenient to street cars. The rooms consist of a large assembly room with a small room adjoining. A dummy waiter will be put in, connecting with the restaurant of Lansing & Sickler immediately below, and the restaurateurs will furnish the services of a waiter for those desirous of lunching in the rooms. The social element, which is designed to be one of the main features of the club, will be promoted by the arrangements outlined. The club rooms will be kept open all the time, will be made the headquarters of those interested in electrical pursuits, and club members will utilize the conveniences of the rooms for out-of-town friends who occasionally come to Chicago.

President Stiles read an invitation from the Boston Electric club to the Chicago Electric club to attend their house-warming at 66 Boylston street, October 5th. The president was instructed to wire the regrets of the club.

J. L. Barclay read the paper on "why electric light companies should distribute and sell power," reproduced elsewhere.

Mr. Buckley asked the reader if he had ever seen a station that ran motors from a converter.

Mr. Barclay replied that he had, but only in the way of an experiment in Pittsburgh.

Mr. Buckley asked if he thought it was practical, and Mr. Barclay answered that looking at it from a dollar and cents point of view, he thought not.

C. J. Van Depoele said in regard to running motors with alternate currents, he had experimented considerably, and the motor seemed to run just as well. He thought it could be done if the alternations were rapid enough. He had experimented, however, only on small motors, the largest being one-fourth horse power, but he did not know anything about the efficiency. Mr. Van Depoele thought that steam engines could be run for eighteen or twenty hours a day, but that an arc light machine neither mechanically nor electrically was made strong enough to run that length of time. After it had done its night's work it should be allowed to rest.

Mr. Leonard asked the last speaker what method he adopted for starting a motor on an alternating current.

Mr. Van Depoele: "I have no trouble at all, I connect it up and start it off."

Mr. Leonard referred to a trip he had made in a street car in New York run by a Julien storage battery. He thought the charging of storage batteries offered another source of revenue to arc light companies, but said that it was a question with him whether a constant potential machine offered a high economy for this work.

Mr. Van Depoele thought that the arc light machine was not at all fitted for charging storage batteries; that its work was to furnish current to arc lamps.

Mr. Sperry always supposed that a constant current machine was better adapted for charging a storage battery, and said that the present practice was in that line.

A. H. Brown on being called upon stated that his experience was very limited and that they had used a 20-light dynamo which was run at less than its normal speed. In the morning they had to put considerable resistance in the circuit but during the day the current gradually fell off; that there might be a resistance of 15 lamps in the morning and at night the resistance of only one lamp.

Mr. Leonard said that Mr. Sprague of the Sprague Motor company, and Mr. Harding, general agent of the company were in the west studying the transmission of power in mines. He hoped they would be able to throw some light on this most interesting matter. He expected that one of the greatest successes in the transmission of power would be in mines.

A hearty vote of thanks was tendered Mr. Barclay for the paper. E P. Warner had been announced to read a paper on automatic regulation of currents but he was suddenly called from the city and was unable to return in time. Mr. Barclay had a brief time to prepare his paper but as a perusal will show, it brings out some very interesting features, particularly in regard to the commercial part of the business, which were listened to and will be read with appreciation.

Electric Street Cars, With Special Reference to Methods of Gearing.[1]

BY A. RECKENZAUN C. E.

PART II.

TRACTIVE FORCE AND MECHANICAL RESISTANCES.

We know from experience that street rails which are exposed to dirt, grit, stones and the like, offer a resistance of at least 20 pounds per ton with the wheels in motion. Taking the loaded car at six tons, and the speed at six miles an hour, we have to exert 1.92 horse-power at the driving wheels, neglecting friction of gearing and losses in the electric motors. On narrow grooved rails, as used in England, we allow a tractive force of from 25 to 30 pounds per ton. These high resistances are readily accounted for when it is considered that the flanges of wheels frequently take a bearing on the dirt in the grooves; at the same time the wheel tires may roll on the surface of the rails, when a regular grinding action is produced. Furthermore, it occurs frequently that one wheel is running on its proper bearing surface, whilst the other, belonging to the same axle, has its flange touching the bottom of the groove, when by virtue of different circumferential velocities, additional friction is introduced. Sometimes the rails are a little out of gauge. All these points increase the tractive force requisite with grooved rails. Here in America you have few if any, such rails, consequently the facilities are superior; but your rails are not so strong as those used in England and on the continent of Europe, and the foundations are less substantial. The joints are also somewhat irregular, and these faults render the motion of a car very unsteady. A ride on some of the roads in Philadelphia reminds one of a voyage on the ocean when the sea is a little rough. Then you crowd very often 70 passengers into a car which is supposed to hold about 30. All these circumstances compel us to provide plenty of power in order that every obstacle can be overcome.

The force necessary for starting a car is of course much greater than the force required for maintaining a uniform speed, and experiments show that this initial effort amounts to three times or even four times the tractive force of the car in motion. In dry weather, on curves of 50 feet radius, the resistance to traction is doubled, and on those of 35 feet radius trebled; but when the rails are wet this resistance, due to curvature, is considerably reduced. With a short wheel base, or, better still, with small trucks or radiating axles, the motion on curved rails is very much easier.

GRADIENTS.

The effect of gradients is a matter of simple calculation, and it must be provided for in designing and constructing a motor. We have calculated above, that the minimum effective power for a six ton car running at six miles an hour on the level is nearly two horse-power, exclusive of gear friction or any other waste. If we have to overcome a gradient of one per cent., for instance, the resistance due to gravity will be 22.4 pounds for each ton, or 134.4 pounds for the loaded car. Therefore we shall require about four horse-power to pull this car up a grade of 1 in 100. With a two per cent. grade we must have about three times the power used on level roads, and roughly speaking each per cent. of grade involves as much energy as the propulsion of a given weight over a horizontal road, if the speed is to be kept constant. On steep grades, however, it is customary to run a little slower, whereby some of the energy is saved, but for a car of the above weight, if it has to overcome grades of four per cent. it will not be safe to have less than eight horse-power available upon the driving axles. In addition to this the motor has to supply the power which is unavoidably wasted in the gearing used for transmitting motion from the armature shaft to the car axle. An ordinary street car wheel of 30 inches diameter has to revolve at least 77 times in the minute, in order to traverse a distance of seven miles an hour. Up to the present time no one has succeeded in constructing an electric motor of reasonable dimensions, weight and efficiency to work at such a low speed. Most of the existing motors revolve at from six to twelve times the above velocity ratio, therefore it became necessary to introduce speed-reducing appliances between the motor and the driving axles.

GEARING.

The problem of devising suitable gearing for street cars carrying their own motors has been and is still one of the greatest importance, and I propose now to offer a few remarks with reference to this subject, by citing some examples which came under my own observation. The conditions to be satisfied are by no means simple, and it is somewhat difficult to arrange them in their order of merit. Most engineers endeavor to retain the recognized dimensions of street cars, because great deviations therefrom involve many inconveniences, and it is wise to adhere as much as possible to the rules which have been established by custom, convenience, and general utility. The fact that most of the street cars in all parts of the world are similiar in shape, indicates forcibly that a particular pattern satisfies the demand. When taking that popular pattern of car and adapting to it our electrical and mechanical apparatus, we find that the space at our disposal underneath the floor and between the axles is meager and extremely limited. Within this small compass we have to fix the gearing which has to give the highest possible return of a given power; it has to be strong, durable, yet light in weight; noise and vibration have to be carefully avoided; the mechanism must be simple, certain in its action, protected from wet and dirt, and finally, of reasonable cost. How to combine all these virtues has been the study of every engineer who has made electrical traction his serious study.

STEEL SPIRAL CORDS. In regard to my own observation one of theprettiest kinds of gearing in actual use is that on one of the cars of the Berlin Lichterfeld Electric tramway which was constructed six and a half years ago by Messrs. Siemens and Halske. This car has a capacity for 24 passengers; it weighs when empty 3.2 tons and makes a speed of 12 miles an hour. The electric motor is fastened under the floor in the center of the car, having its shaft paralled to the axles. On the motor shaft is a small cast-iron pulley, which has 27 V-grooves on its rim, and within these grooves work an equal number of spiral wire cords, which transmit the motion to both axles of the four-wheeled car. The axles carry the large pulleys, one of which has 13 V-grooves on its circumference, and the other 14 grooves corresponding with those on the pulley on the motor shaft. The wheel base is five feet, nine inches, consequently there is only a distance of two feet, ten and a half inches between the centers of the connected pulleys.

The cords are made of a pair of steel wires wound closely upon a mandrel of about one-eighth of an inch in diameter, and when this mandrel is withdrawn there remains a stiff, yet flexible spiral, whose external diameter is scarcely $\frac{7}{32}$ of an inch. When cut to the proper length these cords are stretched over the grooves and connected at the ends by means of steel eyes and a steel link. Experiments made with this gear showed that eight spiral cords suffice for transmitting the power to the axles when the car was full of passengers, and as there are actually 27 cords the margin of safety was deemed more than sufficient. It is a pleasure to ride on this car; there is no noise or vibration, and I was told that the spirals last a long time if carefully adjusted; but this method of transmission is not sufficiently positive to warrant its application on steep grades. On this line there is no grade of over one per cent. rise.

(*To be Continued.*)

1 Read before the American Institute of Electrical Engineers at New York, September 20th, 1887.

Remarkable Dynamite Gun.

For months at Fort Lafayette, Lieutenant Zalinski, under the direction of the government has been experimenting with a gun designed to throw a dynamite bomb. The inventor of the gun conceived the idea of using compressed air instead of powder and of sending the missile by a series of impulses instead of one impulse. Lieutenant Zalinski and others perfected the device so that the dynamite would do no damage until the shell hit something. He invented fuses adapted to a dynamite shell. One was the ordinary percussion fuse, and the other was a contrivance by which the dynamite could be set off by contact with water. In the cap of each shell prepared in this way were put the materials for a miniature electric battery, without the fluid. Wetting this fuse makes an active battery of it, and the current developed heats a platinum wire which explodes the primer of the dynamite shell. Other inventions were made for safety and accuracy, and the dynamite gun was ready to be fired. September 20th the gun was tested with a view of ascertaining what service it would give in sea coast defense against an invading vessel. The government contributed an old unseaworthy schooner, the Silliman, for the experiment, and Secretary Whitney, the naval committee of the house of representatives, General Scofield, General Curtis, the staff officers of Governors Island, S. D. Schuyler president of the Pneumatic Dynamite Gun company, ex-Collector E. A. Merritt, and others of the directors of the company, Senator Hiscock, General Fitzgerald, General King, Marshal McMahon, Colonel Miles, and Danish, German, Spanish, French and Japanese naval officers were present to witness the experiment.

The schooner that was to be practised on was anchored in Gravesend bay. The tide was flowing out, and only its stem was presented to the gun. This made a narrow target about 25 feet wide. The two masts were stripped of sails, and had only the cordage that could not safely be removed. The hull was pretty low down in the water, and as compared with a fleet of war ships the doomed old schooner was like the bull's-eye of a target.

Several trial shots were made to get the range. The pressure of these trial shots was 600 pounds to the square inch, which, through the sixty-foot eight-inch tube of the gun was sufficient to send the missiles a mile. The pressure was increased to 607 pounds, and a real shell was put in. These shells are shaped like huge rockets. There is the cap, with both an impact fuse and a battery fuse. Behind the cap are fifty-five pounds of nitro-gelatine in a brass shell, and attached to that is a brass tail that makes the whole rocket five or six feet long.

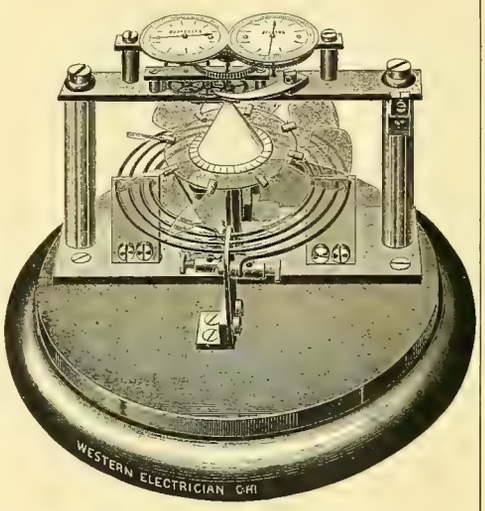
There was a louder hiss when the first loaded shell came, and a little white cloud of escaping air. The rocket hissed along for ten or twelve seconds and then plumped into the water a few yards off the starboard quarter of the schooner. As soon as it struck there was an explosion, and columns of water and spray went a hundred feet into the air, as if a giant whale had just blown. The schooner rocked in the water, and the mainmast tumbled over, breaking the top of the foremast, and carrying the bulwarks and cordage with it. Launches ran out to see what damage had been done, and found that the schooner was leaking, and that the woodwork of her quarter had been smashed. The shell had not struck the boat, but the force of the concussion was enough to wreck it.

The air reservoir was charged again, and in a few minutes the seconded loaded shell went hissing along high enough in the air to clear the topmast of any boat that might have been in the way. It plumped right under the stern of the schooner and exploded. The old boat rose in the air with the mass of water, and came down a total wreck. It was broken to pieces, and the wreckage began to float away. The water tank had been blown up from the hold, and was on top of the deck. The forecastle was kindling wood and the foremast was toppled over on the wreck, while the mainmast, that had been knocked over by the first shot, began to drift off. There were cheers at the success of the experiment, and the whistles tooted as they do at the end of a yacht race. Two other shots were fired to show the accuracy of the gun. One of them struck the rigging of the foremast, and exploding, smashed the wreckage more completely. The schooner was cut from its anchorage and drifted on with the floating pieces of wood from its wreck.

An Electric Current Meter.[1]

By Professor G. Forbes.

At the present moment the mind of electrical engineers is much directed to the successful means of distributing electricity to a large district from central stations by means of that class of induction apparatus which has received the several names of "secondary generator," "transformer" and "converter." This is the only thoroughly worked out system available to the engineer for an extensive supply of electricity. Currents of an alternating character—*i. e.*, alternating positive and negative in direction, the alternations being at the rate of some hundreds per second of time—and of high tension or pressure, are by this system carried from the engine house, by comparatively thin and cheap wire conductors, to the points of supply. The only difficulty which has been met is in the designing of a suitable meter. There is absolutely no meter available that pretends to be reliable. The very best indicates a totally different result when the same current is passed through it, if the number of alternations of the current—*i. e.*, the speed of the dynamo—be altered. It was to overcome this source of trouble and to remove



the last difficulty from an otherwise perfect system of electric distribution that the author undertook the labor of designing and perfecting the meter here described. Some idea of the work expended in bringing it to its present state of perfection will be gained when it is stated that the trial observations during the development of the instrument numbered nearly 10,000. Seeing that the only electrical actions available were those of chemical action, electro-magnetic action and heat; that the chemical method is incapable of being used with alternate currents, and that all electro-magnetic meters must vary in their indications with the rapidity of the alternations, the author was led to base his instrument on the heat developed by an electric current. Such an instrument must be equally applicable to continuous currents and to alternate currents, whatever their rate of alternations. Thus a meter is obtained which is practically perfect and more simple in construction than any of those designed for a more limited range of uses. The instrument is extremely simple, both in principle and in construction. It consists essentially of a flat spiral of iron wire with two terminals. Sometimes these two terminals are united to form one, the other being attached to the middle of the wire. Thus the instrument exhibited may be used as an accurate measure for currents from half an ampère or from one ampère upwards. Above the conductor a set of vanes is pivoted. This consists of a circular disk of mica with a hole in the center, in which is fixed a pinion with a concentric ruby cup. Round the circumference of the mica disk eight small cylinders of pith are fixed at equal distances, and eight vanes inclined at 45° to the mica disk are attached to the pith cylinders, these vanes being made of the thinnest mica. This set of vanes is supported with the ruby cup resting on a steel point fixed to the base of the instrument. The pinion engages with the first wheel of a train of clock-work actuating the indices, which show upon two dials the number of revolutions made by the vanes. The action of the instrument is very simple. The electric current passing through the iron conductor creates heat, which sets up a convection current in the air, and this causes the vanes to rotate about the vertical axis and drive the clock work. The number of revolutions indicated on the dial is, through a considerable range of currents, an exact indication of the number of coulombs or ampère-hours which have passed through the conductor. The friction of the ruby cups on the pivot determines the smallest current which can be accurately measured and the friction of the clock work is imperceptible. The following table shows the performance of one of these vanes. The conductor used had a resistance of .1 ohm; the first line shows the rate at which the current was flowing through the conductor; the second line gives the ratio of current to speed of rotation, a ratio which ought to be constant:

Current in ampères	.25	.35	.45	.6	.75	1	2	3	6	12
Ratio of Current to speed	76	61.25	50.4	51	50.75	51	51	50.7	51	51.6

When using higher currents the ratio is equally constant.

Sir William Thomson complimented the author on having practically solved a problem on which he himself had been working for a long time, but not with the same satisfactory results. He was nevertheless extremely pleased at the success achieved by Professor Forbes, because with the invention of a good and reliable meter one of the obstacles to central station lighting had been overcome. The difficulties of making a meter to correctly record alternating currents were very great, one of them being due to the action of the current upon itself. Even in continuous current instruments a slight variation in the strength of the current will sometimes cause an error due to self-induction. Thus in one of his current balances, the slight variations in the speed of the engines introduced an element of error. Professor Forbes had, however, succeeded in devising a type of instrument in which the self-induction can be made as small as desired, and thus a degree of accuracy to within 2 or 3 per cent. might be obtained, which is quite sufficient for practical purposes.

After several questions from other speakers, Professor Forbes replied that he found absolutely no difference in the working of the meter, whether it was traversed by an alternating or a continuous current. In fact, an alternating current seemed to introduce less apparent resistance than a misdirected current rapidly made and broken. The size of the glass cover he found to be of importance, the larger cover allowing the mill wheel to start with a smaller initial current. An instrument intended for a maximum supply of twenty lamps would start with half the current strength required for one lamp, and would register correctly from one lamp to twenty. The wheel work does not introduce any appreciable friction.

[1] From Report of the Proceedings of the British Association. in *Industries.*

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	385	400
Central Union	44	45
Michigan	72	73
Great Southern	28	30
Colorado	18	20
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27
Missouri & Kansas	68	69

A company has been organized at York, Neb, to put in electric lights. The city council has granted a franchise.

CORRESPONDENCE.

Eastern Electrical Comment.

NEW YORK, October 1.—The state political campaign has been fairly opened by the Henry George party, and the stars are showing remarkable activity, being heard from frequently in three or four places on the same day. It is somewhat unusual in this part of the country, at least, for work of this character to be publicly prosecuted on Sunday, but if this is one of the reforms, it has been fairly started already. Sunday, the 18th ult., was announced for the debut of the telegraphers and linemen of the city, as soldiers of the "cross of the new crusade." Wilbur O. Eastlake presided. John J. Flanagan, of 195 Broadway, congratulated the telegraphers on having at last struck the right road which is to lead them out of the wilderness. He was followed by Louis F Post, Henry George and ex-Father McGlynn, who said that "one of the magnificent results of the new crusade will be, not only to help the poor, but to relieve the wealthy and aristocratic classes of their embarrassment of riches." It may appear strange, but no anxiety has been shown on the part of those particular classes to get rid of their embarrassing surplus, which is perhaps the easiest problem to solve in the whole line of social economy, as one might always depend upon plenty of assistance in the good work. The following is the gist of the resolution adopted: "That we believe it to be a sacred and solemn duty we owe to our country and to our fellow men to affiliate and co-operate with the United Labor party and to aid and assist it in every way possible, to the end of fulfilling its noble objects; that we heartily indorse the nominees of the Syracuse convention and pledge them our earnest and undivided support; that we choose at this meeting the most available, competent, and representative telegrapher to stump the state in the interest of the United Labor party."

It is a matter of general surprise that so small a proportion of practical telegraphers have availed themselves of the rapid development in the electrical field to better their condition. Wherever they have done so they have usually been successful. The *Sun*, of this city, recently mentioned a few prominent men who had become burdened with wealth since forsaking the key. Andrew Carnegie, Theodore N. Vail, ex-Gov. Rufus B. Bullock, of Georgia, and ex-Gov. Cornell, of New York, W. J. Johnston, E. H. Johnson, Thomas Alva Edison, and D. H. Bates. The latter, as is well known, is president of the Baltimore & Ohio telegraph company, and may be considered still in the telegraph business. The list might be extended considerably, there being George B. Prescott, Charles H. Haskins, Jabez Feary, John F. Noonan, P. B. Delany, and many others, none of whom are obliged to worry about their expenses exceeding their receipts.

Electric railway matters continue to make a great deal of talk in the vicinity of New York. The Van Depoele system was recently attacked in a very disreputable manner by some of its rivals before the Elizabeth city council, where it was accused of failures which had not occurred, and of shortcomings which might have been more properly charged to other systems. Whatever progress there is in this direction, and it is not what it might have been, has been due principally in America, at least, to the work actually accomplished by the Van Depoele people, with the exception, perhaps, of the Baltimore road. Others might have done more had they not been handicapped in various ways.

Edward H. Johnson tells a good story of Edison's versatility: "I was traveling through the west for Edison," he says, "giving exhibitions of and lectures on the telephone. Edison had previously told me, in a casual way, that he believed he could make a talking machine, and meant to do it some day. In a burst of enthusiasm at Buffalo I boasted that the wizard would astonish them still more as soon as he could find time to perfect his talking machine. The audience went wild over the announcement, and it was some minutes before I could proceed with my lecture. At its conclusion I was besieged and congratulated by an eager crowd, who extorted from me a promise that I would hurry up that talking machine and exhibit it first in Buffalo. I abandoned the remainder of my trip, packed my gripsack and started for Newark that night. All the way home I was wondering whether I hadn't bit off more than I could chaw. 'Tom,' said I, as soon as I could reach him, 'you must let everything else go and finish that talking machine without delay. The people are crazy over it. I made a bluff at them in Buffalo, and the whole audience called me down.' 'All right,' said Edison, unconcernedly. In three days he received from New York the metal cylinder, and before nightfall the phonograph was an accomplished fact."

The electrical department of the American institute exhibition promises to be more interesting than that of 1884 at Philadelphia, which was devoted exclusively to electricity. Electric lighting had at that date arrived at the "booming" period, and really overshadowed everything with its brilliancy. When the Brush arc lighting system was first shown at the American institute exhibition several years ago it was a novelty. The fact that the building is now to be simply lighted by a complete outfit of arc and incandescent lamps, while the exhibits proper will embrace all the later developments in the electrical field goes far to prove that electric lighting is no longer a novelty, and following in the footsteps of its predecessors, the telegraph, and the telephone has entered upon the stage of an established industry. Although the exhibition was opened on the 28th of September, it was far from being complete, but the steam power was started on the 30th, and within a week everything will be in running order. The building is lighted with Ball arc lamps and Mather incandescents. The historical department, in the hands of James Hamblet and Joseph Wetzler, is exceedingly interesting. In addition to Dr. Franklin's electric machine and Dr. Hare's lightning rods, various motors and telegraph instruments, a very fine collection of numerous styles of telephones is shown, forming a most interesting study. A fitting companion exhibit, if it could be obtained, would be the famous collection of incandescent lamps of all varieties owned by W. J. Hammer, of Boston. The Commercial Cable company shows the siphon recorder in actual operation, also pieces of the shore ends of its cables which had been damaged by ice off the shore of the Dominion. A near neighbor of the cable recorder is the so-called "writing telegraph," which will certainly attract attention for its ingenuity whatever may be thought of its practicability. To write with a kind of stylographic pen on a slip of paper at one instrument and find it reproduced by the movement of a similar pen a dozen feet away is a very pretty demonstration of the possibilities of electro-mechanical devices.

The Daft Electric railway system is represented by a motor car built for the sea shore line at Asbury Park, N. J, also four poles showing the manner in which the overhead conductors are arranged in service. This car is stationary, but along the east side of the building a track is being laid down, over which our country cousins may be whirled for a distance of perhaps 300 feet for five cents. Not a very long ride, but it will be, perhaps, as satisfactory as many of the other catch-penny devices under the same roof.

It is too early to give a detailed description of the various exhibits, but those who fail to recognize their attractions, or believe that they "know it all," and consequently stay away, will certainly miss a very important event in electrical progress.

The various "bugs" and mechanical defects which infested the Field motor having been exterminated, it is now demonstrating its usefulness by shoving a car up and down the Thirty-fourth street branch of the elevated railway for the entertainment of visitors. If a suitable arrangement could be made in connection with the electrical exhibition, to run it at certain hours in the afternoon, say from three to five o'clock, it would be a very appropriate annex, as no extra expense is incurred in visiting it en route to the institute building.

The meeting of the American Institute of Electrical Engineers, September 20th, was as successful as predicted. Mr. Reckenzaun's paper and discussion, although more mechanical than electrical, were well received, and the officers have signalized a new departure in the management by promptly issuing in a neat pamphlet a complete report of the entire transactions. It is believed that this course will be most heartily appreciated by all who are associated with the institute, and whose steadfast adherence to its interests have enabled it to attain a position of usefulness and stability which will be of permanent benefit to the entire electrical fraternity.

Instead of being ruined by Chinese cheap labor, eastern telegraphers are looking toward Asia as a field of usefulness, where their efforts are more likely to be appreciated than they now are in America. Offers of $200 per month and expenses paid are the inducements which it is said are being offered to Morse operators of a proper degree of skill, to join the Wharton Barker telephone syndicate. No difficulty will be experienced in securing recruits as there is always plenty of young men ready to visit China or other foreign parts, and the experience will do them no harm. They will learn to appreciate America if the trip is of no other benefit to them.

The commercial colleges will doubtless profit by any stringency in the supply of expert telegraphers. One of their victims, after a single day's experience, has brought suit against the "manager" of the Western Telegraph Instruction company, of number 8 East Fourteenth street, the "president" of which proved to be Miss E. Bailey. The student paid $40 in advance for four months' tuition, and, like the blacksmith's apprentice at the close of the first day, repented that he had learned the trade. After many fruitless attempts to recover his forty dollars, less the tuition for one day, he waited on his honor the mayor, who advised him to take criminal proceedings, and Miss Bailey in consequence appeared before Justice Patterson, who adjourned the case to enable the prosecution to draw up a suitable complaint. P.

New York Notes.

NEW YORK, Oct. 1.—The American Bell Telephone company has obtained an order from the United States circuit court in Baltimore, restraining William C. Turnbull from furnishing any electric speaking, telephone or telephonic apparatus, embracing the inventions claimed in the Bell patents. The press reports announced this as a move to head off Count Mitkiewicz and nip his Chinese telephone scheme in the bud, as the Turnbull telephone is the kind he proposes to introduce there. E. O. Morgan, one of the American Bell directors referring to the above, is reported as saying: "The Bell company has no interest in that enterprise, and has nothing to do with its telephone arrangements. I do not know anything about the special business of our law department, under which the suit was brought against Turnbull in Baltimore, but I know it is not likely that the company would do anything so foolish as to bring a suit in America to restrain manufacture in China. The fact is, the Turnbull matter is a local issue, and this is one of the numerous suits the company has always on hand against an infringement of its rights in a particular locality. As I understand it, Turnbull has been manufacturing telephones in Baltimore, and our suit is to restrain that, and has nothing to do with Count Mitkiewicz. That feature of the suit is the invention of some one's imagination."

Attachments have been levied against the property in this city of the Postal Telegraph company for $515, the United Lines Telegraph company for $1,475, the American District Telegraph company for $1,500, the Commercial Telegram company for $225, the American Rapid Telegraph company for $1,400, and the Manhattan District Telegraph company $550. The sum in each instance is in direct proportion to the wires each company operates in this city. The attachments are issued for money due the state for the expense of the Subway commission, under the act creating that body. Deputy-sheriffs Delmour and Mulvaney in the name of State-comptroller Chapin filed the warrants of execution. They were received with surprise by some of the companies, while others expected the attachment and were prepared for them. There is no doubt that the companies will combine and oppose the constitutionality of the Subway commission and the levying of attach-

ments to meet its expenses. The assessments, it was learned, will be paid under protest, pending a decision in the courts. Not long ago the Western Union and Baltimore and Ohio telegraph companies were attached for similar reasons, the former for $11,000 and the latter for $2,500. Both of these companies paid under protest.

The Board of Electrical Control has notified the companies having wires along the lines of Broadway, Sixth avenue and Fifth avenue, along the line of conduits now existing, to put them under ground within ninety days. An elaborate plan has been accepted by the board for the distribution of the wires. Mayor Hewitt does not hold a very high opinion of the Board of Electrical Control. At a meeting of the board a few days ago, he was complaning about the Steam Heating company and said that it ought to be run out of the city, and that it was a public nuisance of the grossest type. Mr. Gibbens suggested that the company should be placed under the control of the Board of Electrical Control. "The one is as bad as the other," replied the mayor.

The limit to the messenger boys usefulness has not been reached yet. A Boston paper gives an account of a messenger boy recently seen lugging a very much astonished baby which he was to deliver at a house not far distant. It was said that he did not loiter on the way with this burden on his hands.

Capt. Henry O. Cook a manufacturer and inventor of electrical apparatus, was killed by a train at Maplewood, N. J., week before last. He was formerly lieutenant-commander in the Indian navy. He came to this country in 1864 and established a manufactory of electrical appliances at Portland, Me. Afterward he removed the factory to Boston. He has lived in New York since 1879, and for the last five years has been continuously engaged in experiments in electrical machinery and motors.

A trial was made of an electric car on Fourth avenue lately. To the average citizen here, an electric car is as much of a novelty as was the first steamboat on the Hudson, so the sight of a car going at full horse car speed, without any horses or visible means of locomotion, created very general curiosity and surprise. The Sprague motor was used, this was driven by storage batteries placed under the seats in the car. The armature of the motor was connected to the axles of the car wheels by means of gearing. The trial is reported to have been satisfactory as far as locomotion went, the car being under perfect control and going up some sharp grades with ease.

At the last meeting of the Electric club H. D. Hall secretary of the Consolidated Railway Telegraph company, extended an invitation to the club to visit the New Jersey division of the Lehigh Valley railroad to inspect the practical working of the system of induction telegraphy in daily operation there.

The trustees of the village of Mount Vernon are considering the advisability of introducing an electric fire signal service, It is proposed to have an alarm placed in each fireman's room, which will be set off from the fire boxes in the street.

The Metropolitan company is stringing about 500 yards of fifty-wire cable on Fulton street. It is only to be used until the subway along the line is completed.

The steamship State of Nebraska brought over from Glasgow this week, the hull of a propeller yacht which is to have an electric motor. It is said to be the property of George Westinghouse, the patentee of the celebrated air brake.

The latest swindling game has been played this week by a fellow who got hold of some Baltimore and Ohio delivery blanks, and who delivered alleged telegraphic orders from business men to their families to pay him money. Quite a number of Fifth avenue residents were caught by the game.

The report comes from New London that electric lights in country towns are deadly enemies to birds of passage during the migratory season. The streets of New London one morning recently were strewn with the mangled bodies of little gray birds that had been sifted out of a flock that had passed over the city during the night. They were attracted evidently into the city by the white glare which they probably mistook for daylight and as they swooped down through the streets, were cut to pieces by the tangle of telephone, telegraph and electric light wires. Other towns report similar occurences.

John E. Hudson has been elected president of the American Telephone and Telegraph company, and E. J. Hall, Jr., vice president and general manager. T. N. Vail the former president, resigned on account of his other duties, but still remains in the board of directors.

The opening of the Metroplitan's new exchange has been delayed two or three months, on account of certain changes that have been decided on. The exchange is to be made for metallic circuits and a new form of office cable used.

The telegraph operators in the various local offices at Philadelphia are excited over the engagement of a number of operators in New York by the Mitkiewicz-Barker-Chinese telegraph and telephone syndicate. E. Barberie, an old operator, who recently returned from China with Mitkiewicz and the Chinese legation, who is hiring the men, is expected in Philadelphia in a few days, and many operators are anxiously waiting his arrival. The syndicate, it is said, is offering $200 per month and free passage to China for good operators, and as outside the desire for a change the price offered is almost three times as great as first-class wages here, there are not a few operators who have expressed a desire to engage with the syndicate. S.

Detroit's Budget.

Detroit, Mich., Oct. 1.—One of the last acts of the upper house before its expiration by limitation, was the awarding of the public lighting contract for three years to the Brush company. This much discussed question seemed to have at last been settled, but some argus-eyed politicians thought they saw defects in the call convening the upper house which was signed by the president *pro tem.*, and questioned the legality of the award. This re-opened the whole affair. The mayor declines to sign the contract until the city's legal officers have rendered their opinion as to the power of the upper house to act in the matter. Even should the action of the upper house be declared legal, it is quite probable the mayor will refuse to concur, objecting to the conditional part of the contract referring to underground wires. On this underground question he has taken quite a positive stand. He says there is no experimental element connected with the work; that underground wires are feasible and practicable; that he has documentary evidence to this effect, and to accept any contract with a provisional underground clause, would be a step backward, which he will not take. The Brush companies contra evidence as to the impracticability of underground wires has no effect. Thus the matter stands. In the meantime Detroit continues to be one of the best lighted cities in the country. The contract was as follows: The company to light 122 towers and 121 pole lights, and furnish light for the city hall and market building as follows: Three years, $117,940 per year; two years, $120,215 per year; one year, $124,463. Extra towers for the three year contract, 60 cents per light per night, extra poles, 50 cents per night, foliage lights for six months, 55 cents per night; for two years, extra towers per light per night, 90 cents, if ordered the first year, and one dollar if ordered the second year; for one year, towers per light per night, one dollar if ordered before January 1, 1888, or $1.25 after that; pole lights, 75 cents before, and 90 cents if ordered after January 1, 1888.

All the bids are made with the stipulation that the company's wires should be allowed to remain overhead, the company agreeing that it will begin the experiment of underground wires, by putting all its wires on Woodward avenue, between the river and Grand Circus park, underground; that if it is a success it will bury all its wires in the district bounded by the river, Grand Circus park, Second and Beaubien streets by July, 1888, and will by July, 1890, bury all of its private wires in the city. A further condition is that the city shall not allow any other company to train private lighting wires overhead.

Sept. 24th, while conveying representatives of the press and board of trade to Senator Palmer's farm, occasion was taken to test the power of the Fisher motor. On the outward trip a speed of 25 miles per hour was maintained. On the homeward run, 49 passengers being in the car, 33 miles per hour was attained. Mr. Fisher, the inventor, who had charge of the car, received quite an ovation. A much higher speed, he said, could have been developed. This roadbed is an unusually good one, and being a suburban road, free from traffic, the unusual speed, was unattended with any mishap. C.

Omaha Gossip.

Omaha, Oct. 1.—The Omaha Motor Railway company are making rapid progress on their lines and promise to be in running order by the holidays. The Van Depoele system will be used.

The American District Telegraph company are doing an immense business and are extending their lines in all directions. Their night watch service is gaining rapidly in public favor and is proving a great success, the insurance rates being decreased in many instances where it is used. A new sub-plant has been started at South Omaha, intended to cover the several large packing houses at that point.

In the last letter Mr. O'Brien was credited with the sale of the United States plant at Higgins' restaurant. It should have read, C. C. Warren, 216 LaSalle street, Chicago. The United States company have contracted for a number of isolated plants in this city and state.

H. B. Warren, of Kansas City, was a visitor here this week. He reports the installation of a 1,500 light plant of the United States system in the Nelson & Weller building in that city. He also reports that several other plants will be put in at once.

The Omaha Illuminating company, Frank Warren, secretary, will very shortly increase their capacity here, so successful have their incandescent lights been. About 1,000 incandescent lights and 40 arc lamps are in use.

The Lincoln Electric Light company have contracted for an extension of their lines, with a view to adding incandescent lamps to their already good arc business. The contracts are limited to Nov. 1st. Plattsmouth and York, this state, will soon have new plants. Columbus, Neb., has three plants in successful operation, and all claim to be making money. This speaks well for a town of 8,000 population. W.

The St. Louis Exposition.

St. Louis, Mo., Sept. 29.—The exposition this year bids fair to beat the record of any previous year. The exhibits, for novelty of design, magnificence, and number have never been equalled in this city and in the opinion of many have never been equalled by any similar exposition in any city. A number of brilliant features have been secured and as a consequence the attendance of spectators is large.

Machinery hall this year is brilliantly lighted by arc lights which supplant the incandescent lights used there last year. The St. Louis Western Electric Light & Power company put the system in. In addition to the lights on this floor there are twenty-five arc lights on the Olive street front, including two on the flag staff on top of building, which can be seen for many miles. There are four each on the Thirteenth and Fourteenth street sides of the building, and then a row of them are strung about the high arches of the respective naves which make a really brilliant effect. These lights are on eight circuits of wire. Sam. T. Baird superintendent and electrician of the company has had entire charge of the insulation and he is to be commended for the thorough manner in which he has done his work. The company began business in this city in May last and from their down-town station are now supplying eighty arc lights for commercial uses, with capacity for fifty more.

There are three engines employed in connection with the arc light system. The first on the line is a Russell high-speed automatic engine, built by Russell & Co, Massillon, O. It is 12″x18,″-75 horse power and runs two 35-light dynamos. It is a handsome engine and is doing its work splendidly. The next is an Erie slide

valve engine, built by Cleveland & Hardwicke of Erie, Pa. It drives a 35-light and a 12-light dynamo. The third is an Armington & Sims engine placed by the Pond Engineering company, and it is driving one 35-light and one 6-light dynamo. It is hardly necessary to add that it is doing its customary good work in the line of close regulation and economy. C.

In the Mining Districts.

DENVER, Col., Sept. 22.—Within a radius of five miles of Leadville, Col., no less than 8,000 horse power is used for mining purposes. The Arkansas river runs within eight miles of the farthest mine that is figured in the opening statement. It is supplied by small mountain streams throughout the year, and it can furnish twice the amount of horse power used. At Leadville coal costs from six to eight dollars per ton.

Clear creek is a stream that runs through the mining district of Georgetown, Central City, Black Hawk and several other towns. It would supply several hundred horse power. Coal is sold at four dollars to four dollars and fifty cents per ton.

Roaring Forks is in the mining districts of Aspen and Independence. There is at present a Brush plant on this stream, which lights the city of Aspen. It is run by a Victor turbine. This stream could supply several hundred horse power. Coal is fifteen dollars to eighteen dollars per ton; wood is six to eight dollars per cord.

San Miguel is situated in the Red mountain, Silverton and Uray mining districts, and it can furnish thousands of horse power, which, if electrically transmitted could be made available by half a dozen cities of from 5,000 to 22,000 inhabitants.

The Rio Grande river and the Platte river running through the beautiful city of Denver, could also be utilized.

The foregoing covers, in brief, a list of the available water powers at command in some of the principal mining districts of the west. A large proportion of the power is going to waste, for the reason that up to the present time no means have been taken to transmit it to places where it could be utilized. Your correspondent has urged the adoption of electric motors, and believes that even at 50 per cent. loss in efficiency they would prove valuable investments, and especially so in places like Aspen, where coal costs from fifteen to eighteen dollars per ton. S.

From the Pacific Slope.

SAN FRANCISCO, Sept. 22.—At Grass Valley during the fair, a model showing the operation of a quartz mill, hoisting works, drilling and pumping was shown. It was actuated by an electric motor on a Waterhouse arc circuit. A great deal of interest was taken in it by the leading mining and milling men.

The Canadian Pacific Railway company are building two new steamers for the sound route, and will make them the most complete in respect to electrical equipment of any on this coast. The Edison company here have contracted to put in Edison plants.

St. Helena, Cal., is contracting for electric lights to light the town; population 5,000.

Excursion trains ran from all parts to Sacramento on the 13th ult. to an auction sale of lots, where it was announced that lots would be sold with the assurance that an electric road would be built inside of eighteen months. The announcement was received with applause on the part of the buyers.

Old California was connected by telegraph with Lower California this week, the first message was to President Cleveland. S.

Indianapolis Items.

INDIANAPOLIS, Sept. 26.—During the past week the Jenney Electric company have received orders for a 300-light incandescent plant at Holton, Kan., and a 200 incandescent light plant from Lapeer, Mich. The same company also shipped two car loads of machinery to the Pacific coast, which completes a large order there.

There is more trouble ahead for the Central Union Telephone company, in the northern part of Indiana. A special to the Indianapolis *News* says: "Valparaiso says telephone lines and poles must be removed from the streets." The same special also says Valparaiso people are seriously contemplating lighting the city by electricity.

The Indianapolis Brush electric lighting station was compelled to shut down one evening last week, owing to the breakage of a part of the machinery. M.

Cincinnati Chat.

CINCINNATI, Oct. 1st.—At a regular meeting of the Brush Electric Light company, Tuesday, September 27th, a quarterly dividend of 1½ per cent. was declared. This speaks well for the company, considering the difficulties under which they have labored.

The medical battery manufactured by the Cincinnati Electrical company,—one of H. B. Cox's patents—is meeting with success wherever introduced. One of the leading features of the case is that the opening of the lid automatically turns on the current, and, using the Cox gelatine cell, the battery is always ready for use.

A test of the Waldumer electro-magnetic brake was made recently on the C., W. & B. railroad. There were a baggage car, three passenger coaches, General-manager Stewart's private car, a gondola and a caboose equipped with the brake of the train, and the engine and caboose were manned with dynamos. The first test was made on an emergency stop, with the train going 49 miles per hour down grade. Steam was shut off at a white guidon and the brakes applied from the engine at a red guidon 330 feet below. The time between the two guidons was 4 3-5 seconds. The train stopped in 25 seconds 974 feet from where the brakes were applied. The next was a "breakaway." Time between the two guidions was 4½ seconds, running fifty miles an hour. At the red guidon the pin between the engine and baggage car was pulled out, and the engine darted ahead. The brake in the caboose was applied, and the train came to a stop 874 feet below in 22 seconds. M.

Personal Paragraphs.

H. B. Thayer, manager of the New York office of the Western Electric company, was in Chicago a few days last week.

Maurice Louis Guiraud, who is at the head of the telephone company operating in Mexico City, Mexico, has been spending some time in the east investigating improved forms of telephonic apparatus.

THE ELECTRIC LIGHT.

A portable electric lamp is shown in the committee room of the house of commons, England, which yields a light of two and one-half candle power for twelve hours at a cost of one penny.

The council of Washington, Kan., voted a franchise to the electric light company for twenty-five years. The mayor has not yet approved the ordinance.

A special dispatch from Carthage, Ill., dated Sept. 19th, says:—"The Warsaw Electric Light company has made an assignment to George J. Rogers for $3,000 liabilities."

The audience at Wallack's theater in New York, was recently treated to a sensation not down on the bills. The play was drawing well toward the close, and De Wolf Hopper was finishing his topical song, which ends with a burlesque on Boulanger, and the snapping of a toy pistol in mockery of the famous Frenchman's dueling proclivities. Just then a ball of fire was seen to drop upon the stage, and an instant later a stream of water shot through from the flies, followed by a fireman, who rushed upon the boards in full view of the auditors. Down shot the curtain, and the cry of "Fire" from the rear of the parquet resounded through the auditorium. There was a wild break for the exits and a panic seemed inevitable, when, as by the waving of a magic wand, up rose the curtain again, revealing the irresistible Hopper, serene and smiling as a summer morning. The trouble was caused by the disarrangement of the wires which supply the large electric lamp which lights the stage from above. This light was concealed from the audience by the lambrequin above the drop-curtain. They noticed the light suddenly flare up, and a moment later the carbon pencil which feeds it snapped and fell to the floor. To the audience it seemed as though the stage settings overhead were ablaze, and the fiery particle had dropped from it.

THE TELEPHONE.

A crazy woman, who was agent for a book on the lunatic asylums of the country, struck Vicksburg a few days ago. She entered the telephone office, chased all the telephone girls out, and shut off telephone communication for an hour.

About twenty Turnbull telephones are in use in Rochester, N. Y.

The subscribers to the Meridian Telephone exchange of the Great Southern Telegraph & Telephone company now number over sixty. The manager is A. M. Johnson, of Mobile, Ala., who has had a wide experience in this line.

THE TELEGRAPH.

The Western Union has now four quadruplex wires from San Francisco east.

Said Colonel Clowry to a San Francisco reporter recently, "The business in California has been getting ahead of us, especially in the southern part of the state where our comparatively limited facilities have given the people just grounds for complaint. Our party is now out for the purpose of inspection and reporting on needed repairs and new improvements. We are now engaged in laying a short route to Sacramento from this city. Heretofore all telegraphing from this city to Sacramento has been done by way of San Jose. The short route will necessitate the laying of another cable to Oakland. Our Oakland cable is now used only for local business. We already have a seven-wire cable across the straits of Carquinez. We are also rebuilding a line from Colfax to Reno, which I think will be the finest in the world. It will consist entirely of copper and large guage iron wire. The poles for this new route were brought from Michigan during the low freight rates and are of the most durable cedar. We are also rebuilding from Port Costa to Lathrop, from San Jose to San Francisco, and from San Jose to Templeton. On the route to Oregon we are engaged in removing the line from the highway to the railroad. In some cases the line will have to be swerved from its original course ten miles. In southern California we are equally busy. We are putting up new lines from Los Angeles to San Bernardino, to San Diego and to many smaller towns not yet touched by telegraph wires. An additional line is under construction from Mojave to Albuquerque. We now use the Atlantic & Pacific's lines between those points. Our new line will also be used jointly by that company."

NEW ENTERPRISES.

The Young Men's Christian Association at Kansas City, Mo., are to have a new building which will cost $110,000. It will be provided with electric bells. E. E. Richardson is president of the association.

The Belt Line road is to build a passenger and freight depot at Kansas City, Mo., at a cost of $200,000. It is to be lighted by the electric light. Burnham & Root, of Kansas City, are the architects.

Jacob Barzen, of 1623 Wyoming street, Kansas City, Mo., will build a residence to cost $4,500. It will be provided with electric bells.

The Inter-state Rapid Transit company will build an engine-house at Kansas City, Mo., at a cost of $20,000. The mechanical engineer is Robert Gildam, Sheidley building, Kansas City, Mo.

George D. Rand will erect a store and office building at Keokuk, Ia., to cost $9,000. Electric bells will be put in.

J. D. Spalding, of Sioux City, Ia., will build a residence to cost $10,000. It will be modern in all respects.

Miscellaneous Notes.

Dr. Milton J. Roberts, of New York, is the inventor of a saw operated by electricity for surgical operations, by means of which a man's leg can be amputated in five seconds.

The Odessa mill, Calico district, San Bernardino county, California, and the Drumlummon mine, Montana, have been fitted with the Rae apparatus for treating ores.

George Wright and William McClure, of Junction City, Kan., are at work on a patent electrical signal for open switches. The appliance is designed to ring a bell in the cab of the engine, giving the alarm of an open switch a half a mile or a mile off.

A system of protection against water overflows in buildings has been brought out in New York. It is essentially a system of electric contacts and electro-magnets worked by a limited number of cells, and controlling weighted levers which operate the water cut-off cocks or valves. For each building, as desired, one electro-magnet of the ordinary well-known form is provided, and the several water-tanks, basins, bath-tubs, etc., are furnished with floats, which, when the water has risen to a certain height, complete the electric circuit. The armature of each electro-magnet is furnished with a notch in which rests a lever attached to the water cut-off valve. When the current passes, the armature is drawn to the magnet, and the valve lever, which is weighted, being deprived of support, falls and shuts off the water supply. An alarm bell is arranged to ring at the same time. It is obvious that so long as the current continues to pass, the water valve lever cannot be held up by the notched armature, and hence the water supply must remain cut off for the time being.

New Orleans still clings to its old volunteer fire department. With the exception of a few paid employes, who are stationed in the engine houses, and those who maintain the city fire alarm apparatus, the department is composed of business men and laborers, who respond on call.

The open board of trade in Chicago has been receiving market quotations by a wire connected with a ticker in a bucket shop. In order to throw the spotters off their guard the members had fitted up a dummy telephone and made a pretense of receiving their market news through that channel. The big board has not yet succeeded in cutting off all the bucket shops, and still the interesting fight is going on.

Richard Bemish of Rochester, N. Y. has invented and patented a hotel fire escape which is regarded by hotel men as one of the best yet brought to their notice. It consists of a flexible ladder which rolls up compactly in a small box varying in size according to the length of the ladder. The box is entirely closed and can only be opened by an electric wire or cord from the office. In case of fire the boxes are opened by touching a button in the office, which throws the lower half of the box open, allowing the ladder to drop ready for use. At the same time a vigorous guest call is sounded. If desired the box may be arranged to be operated by a guest by means of an extra connection.

A resident of Plymouth protects his grapevines from fruit thieves in a novel manner. The supports are of wood, but the cross-pieces are of wires insulated from the ground and connected with an induction coil capable of delivering a heavy spark through an inch of air. The other pole of the coil is connected to the ground. Six good sized bichromate of potash cells furnish electro motive force for the coil. Short wires hanging among the vines are secured to the large wires, and when any one monkeys with the grapevine while the battery is connected the neighborhood is apt to hear from him. It works every time, and no one comes for a second dose.

The early-closing season at the watering places and mountain resorts has set in, and the pleasure seeking army is on the homestretch, making good time. As the New York woman says when she goes down the steps in June, and looks behind her at the tightly-closed house: "Oh, how nice it will be to come back next September!" I hope every woman didn't make the mistake that Mrs. Careful did. She was on her way to Europe, and, after she was seated in the carriage bound for the boat, she remembered a liver pad that she had bought for the old man. "I'll just run back to the parlor for it," she said. "Don't be a fool, but stop at the druggist's and buy another," said he. "As if I would, after buying that," and out she climbed. With three keys she let herself in, flew to the parlor, turned up the gas with the electric key, and searched. Then she ran up to the front room, lighted the chandelier, and found the pad. She triumphantly made her way out of the house, locked it carefully up again, and rode away in victory, having had her way and saved 75 cents. That was on June 3rd. She arrived here on September 3, and was astonished to find the parlors cheerfully lighted to receive her. She had forgotten to turn off the gas, and for three months, night and day, two burners have blazed away and illuminated the industry of the merry moth and the beautiful buffalo bug. When her husband pays his summer gas bill he will think liver pads the most expensive thing he ever struck.—*Pittsburgh Dispatch.*

The meters which gas companies introduce into our houses are put together with solder that melts at a low degree of heat, says *The Engineer*. When a fire originates near a gas meter, the heat soon causes it to fall apart, and the unchecked flow of gas from the influent pipe quickly fills the premises with a roaring and devastating flame. After every fire, when there is a total loss of the building, a blazing stream of gas roars on beneath fallen walls and debris until measures are taken to stop the supply of gas from the street mains. With these facts before everybody's eyes, it seems strange that no attempt is made to have meters differently constructed or some way devised to prevent the loss that necessarily results from the present state of things.

Business Mention.

A dispatch from Portland, Me., under date of the 21st ult. says: "The annual meeting of the stockholders in the Consolidated Electric Light company of this city was held at the company's office this morning. The annual report shows the business to be in a flourishing condition, with a growth as surprising to our citizens as it must be gratifying to the stockholders of the company. The company's property is located in the heart of the city, and, including the new block just completed, covers about 16,000 square feet of land. The arc light apparatus was put in by the American company, which owns a controlling interest in the plant, and the incandescent apparatus is from the Edison company. The company lights the entire city of Portland, and it is claimed that we have the best lighted city in America. It is understood that its capacity for arc and incandescent lights is soon to be largely increased and extended. Up to the present time the American company of New York has been pretty much the sole owners, but it is evident from all that can be gathered to-day that a big combination has been formed between the American company and what is familiarly known as the New Haven syndicate. This syndicate is composed of bankers and capitalists of New Haven, Conn., which it is said have a capital invested in electric lighting plants in different parts of the country amounting to several millions of dollars. Its operations in New England cover the electric lighting business in Boston, New Haven, Springfield, Bridgeport, Newport, and Waterbury, besides several smaller cities. The syndicate is under the management of F. A. Gilbert, president of the Boston Consolidated company; James English, treasurer of the New Haven, Bridgeport, and Newport companies, and H. P. Frost, general manager of the Southern New England Telephone company. These gentlemen were elected on the board of directors here to-day. If this means a combination with the American company, it will help to strengthen the general business of electric lighting wonderfully. From the fact that the American company is about to move its entire factory to New Haven and double its facilities, it looks as though a combination had been made upon an immense scale. The board of directors elected to-day is as follows: Weston F. Milliken, William R. Wood, Franklin J. Rollins, Charles R. Milliken, Frank A. Sawyer, Portland; F. A. Gilbert, James English, H. P. Frost, New Haven, Conn.; Silas Gurney, Boston; E. H. Goff, New York."

The Gaynor Electric company, of Louisville, Ky., is a recently incorporated company, capital stock $200,000; officers, John H. Sutcliffe, president; John J. Barret, vice-president; E. D. Hobbs, jr., secretary and treasurer and Thos. F. Gaynor, superintendent; directors, Charles R. Long, C. A. Warren, John J. Barrett, T. F. Gaynor and John H. Sutcliffe. The company will manufacture the rapid fire alarm and police signal system and general electrical goods and will handle electrical supplies.

Cyrus Emery, general agent for the Bain motor has conveyed the exclusive right of sale for the motor for several eastern states to eastern parties.

The Chicago Cable Railway company has ordered a 15 light plant for its shops on Twenty-first street, of the Western Electric company.

The United States Electric Fire Alarm company of Evart, Mich., are doing a large and constantly increasing business in police patrol and fire alarm telegraph systems.

The Woodbury Engine company, of Rochester, N. Y., have sold one of their new style high speed automatic cut-off engines, size 10" x 14", to the Powers Hotel company, of the same city, for driving their dynamos; an 8" x 12" engine of the same style to the Rochester Paper company, of the same city, for driving one of their large paper machines, and another 8" x 12" engine of the same style to L. C. Healy, Arkport, N. Y., for driving a grist mill.

Electrical Patents.

Issued September 27th, 1887.

370,423. Electric Lamp. Joseph J. Skinner, Boston, Mass. The feed mechanism embraces two electro-magnets, the cores of which are rigidly connected by the same bar. One magnet is pivoted at the end which is opposite the free end of the armature, the pole of the other being presented towards the same armature opposite its fulcrum. The armature may approach the pole of the pivoted magnet but not the pole of the other which is suspended above the pivotal point and which approaches the armature when magnetized.

370 424. Elecric Lamp. Joseph J. Skinner, Boston, Mass. This is a double carbon lamp. The carbons may burn simultaneously or intermittently.

370,434. System of Electrical Distribution. Ferdinand A. Wessel, Brooklyn, N. Y.

370,439. Electric Burglar Alarm. James B. Yeakle and Arthur Steuart, Baltimore, Md.

370,477. Telephone. Hammond V. Hayes, Cambridge, Mass.

370,528. Electric Cable. Francois Borel, Cortaillod, Switzerland.

370,572 Electric Arc Lamp. Elihu Thomson and E. Wilbur Rice, jr., Lynn, Mass.

370,573. Regulating Device for Alternate Current Circuits. Elihu Thomson, Lynn, Mass.

370,575. Electric Speed Regulator for Revolving Motors. Francois Van Rysselberghe, Brussels, Belgium. The invention consists in the method and apparatus by which the motive power or the resistance to the motive power is controlled by the movement of a runner upon a parabolic track, and is dependent upon the position of said runner upon said track.

370,576. Repeater for Harmonic Telegraphs. Francois Van Rysselberghe. Brussels, Belgium. Two main lines, after passing through the secondaries of their respective induction coils, unite at a ground branch. The magnets of the receiving instruments are included in the ground branch and the tuning forks of said instruments are each included in a local circuit, and serve to control transmitting devices in a local circuit. Messages may be repeated over the main line in either direction.

370,577. Phono-Multiple Telegraphy. Francois Van Rysselberghe, Brussels, Belgium. By this invention large numbers of separate messages may be simultaneously sent in the same or opposite directions over a single line to a great distance by the use of a very small source of electric energy.

The theory of the invention is mathematically demonstrated in the specification. The method claimed consists in "superposing upon the line series of isochronic simplex electric waves, and translating such waves into audible signals."

The nineteenth claim is as follows: "The combination with a transmitting cylinder having insulated spaces, of a generator of low resistance, derived circuits therefrom, each connected to and controlled by the cylinder resistances and pegs in each derived circuit, a single primary for all the derived circuits and a main line including the secondary and the receiving instruments in branches of the main line substantially as described."

370,605. Coupling for Electro-Pneumatic Brake Systems. J. Fairfield Carpenter, Berlin, Germany.

370,691. Printing Telegraph. Stephen D. Field, New York, N. Y.

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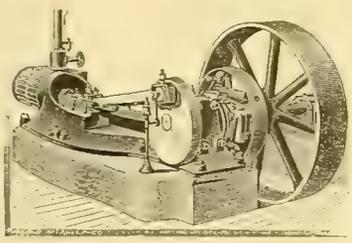

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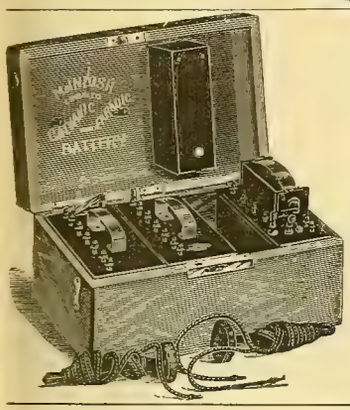

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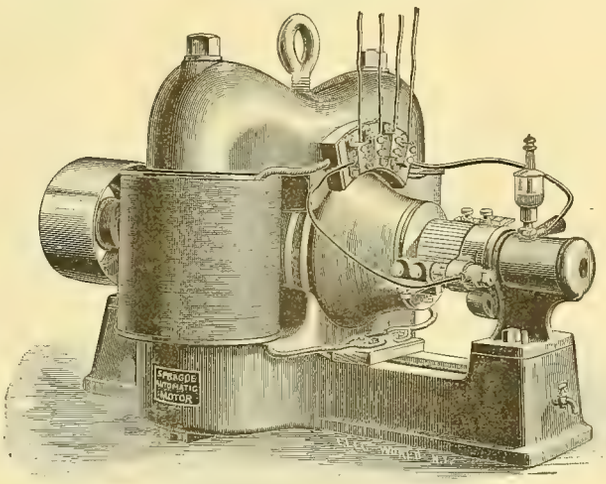

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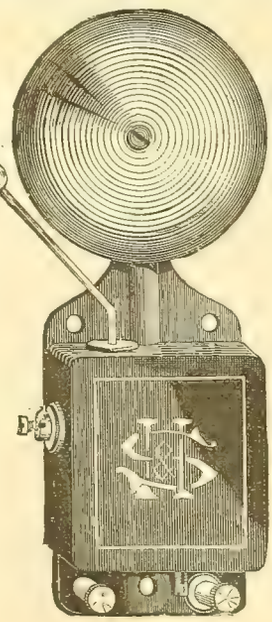
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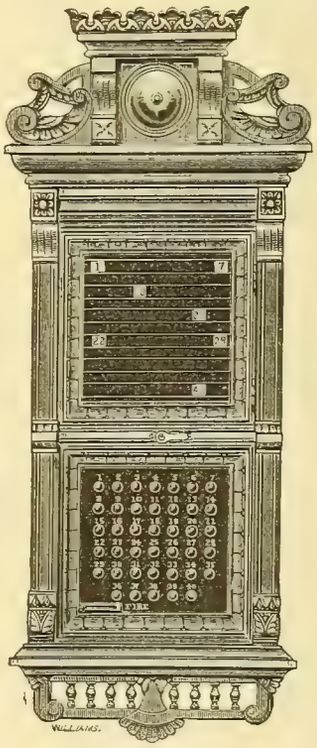
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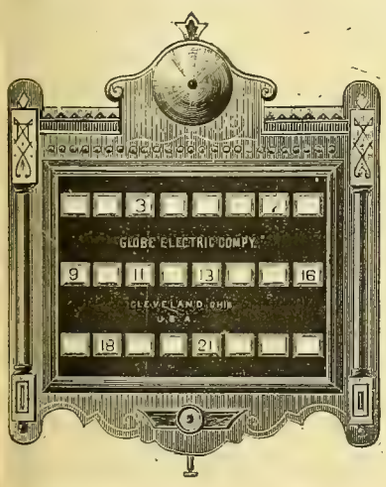

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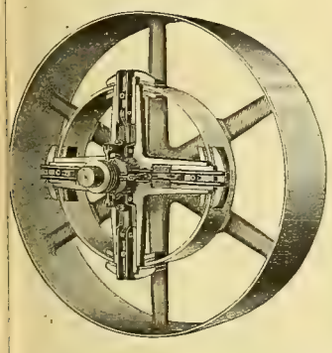

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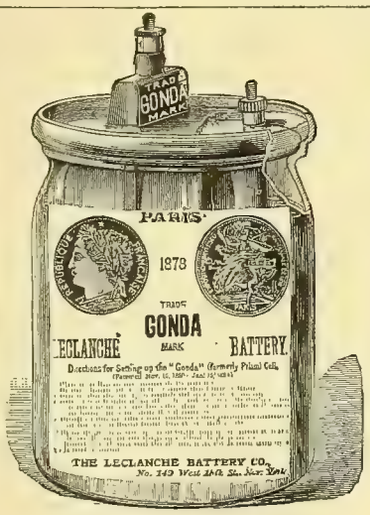

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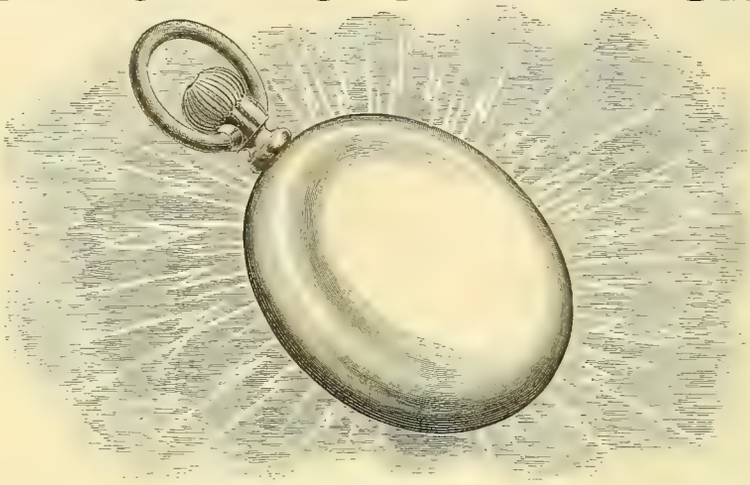

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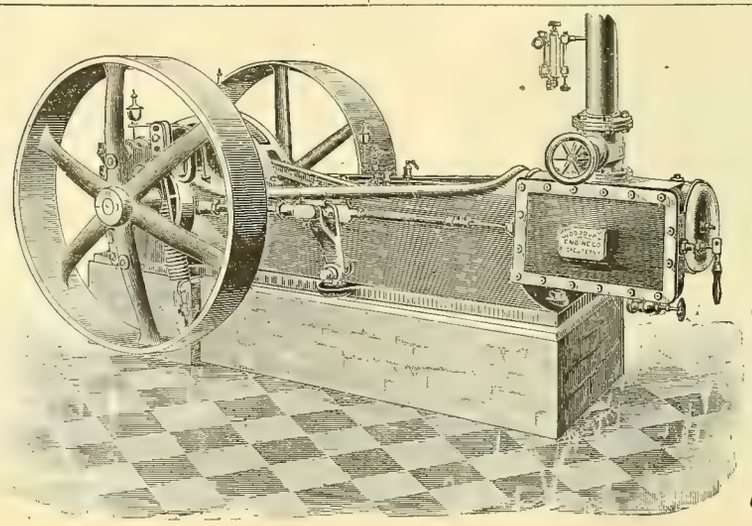

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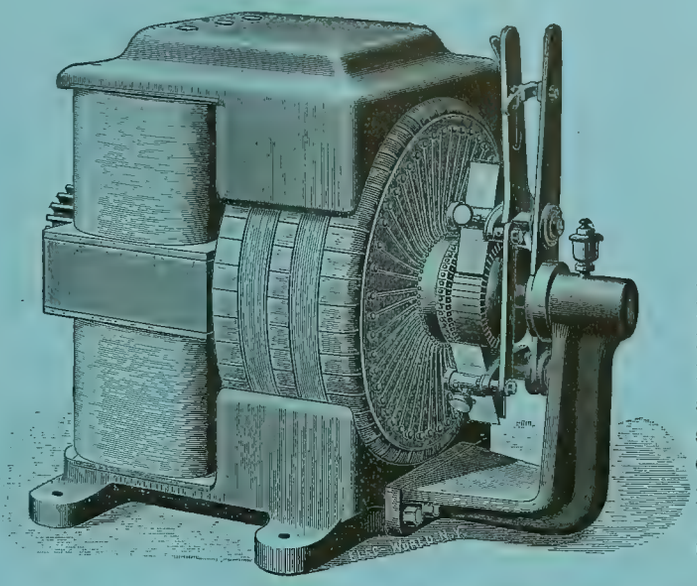

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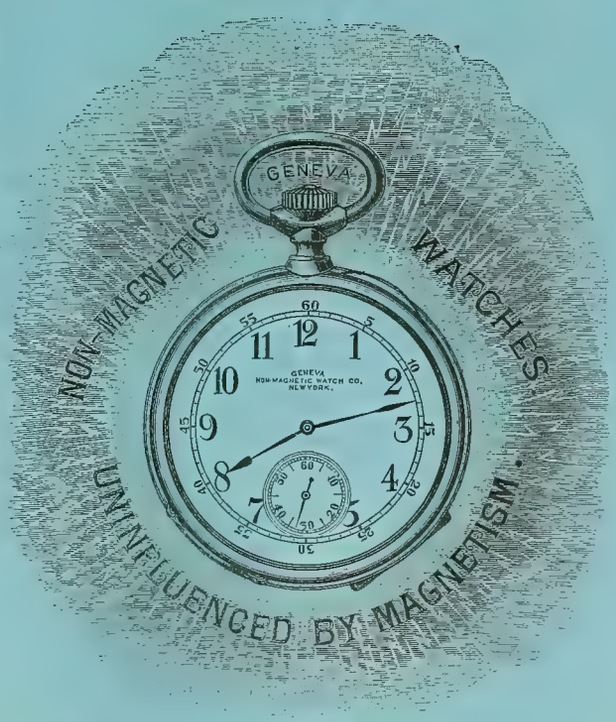

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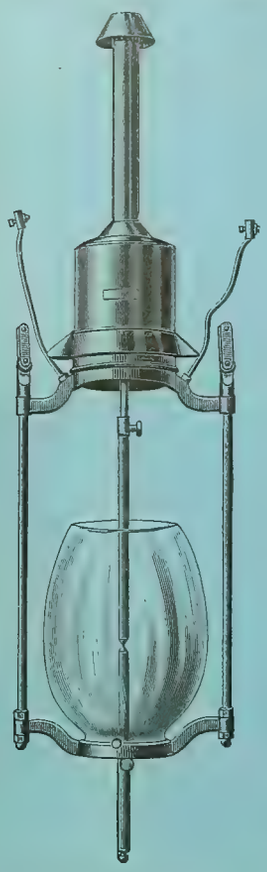

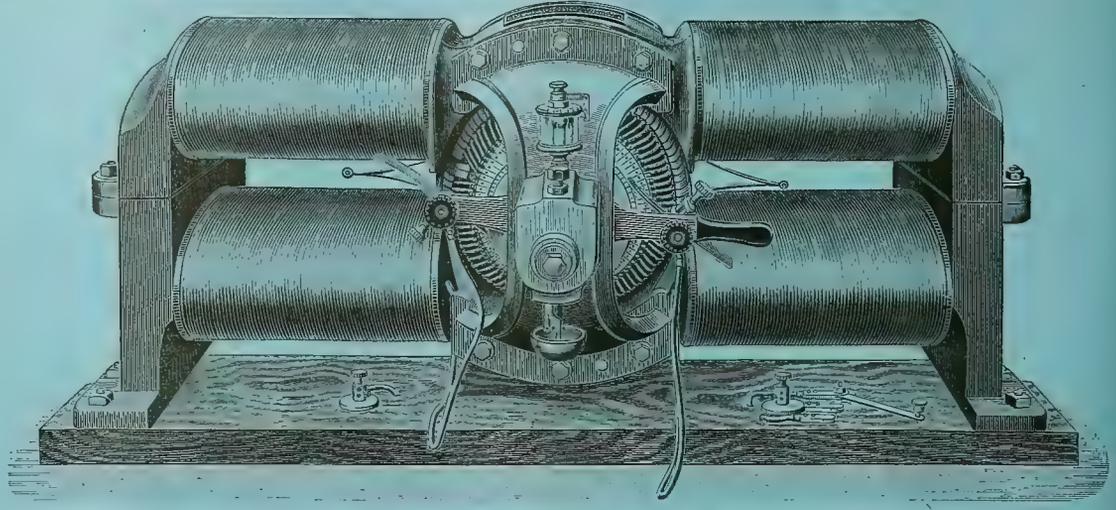

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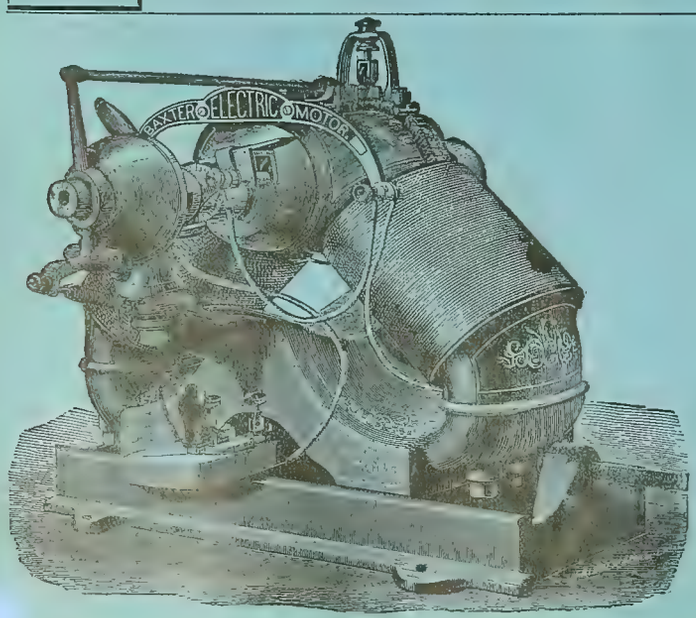

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Vol. I. CHICAGO, OCTOBER 15, 1887. No. 16.

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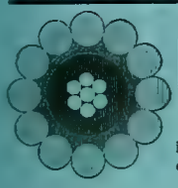

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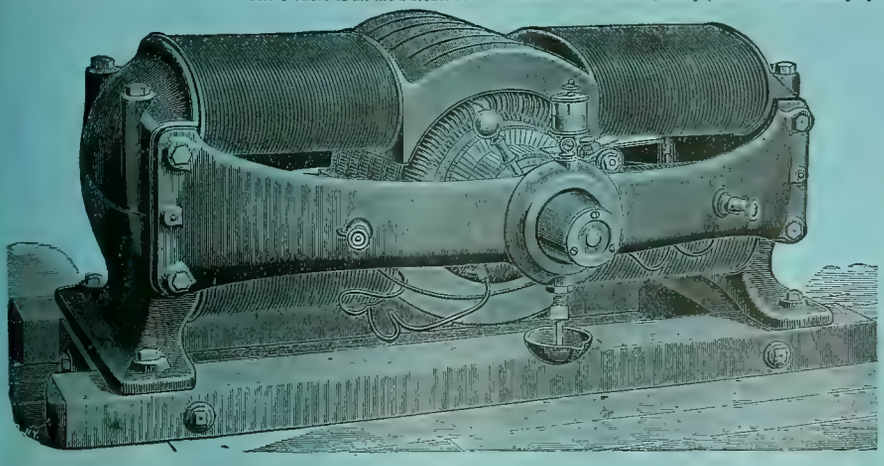

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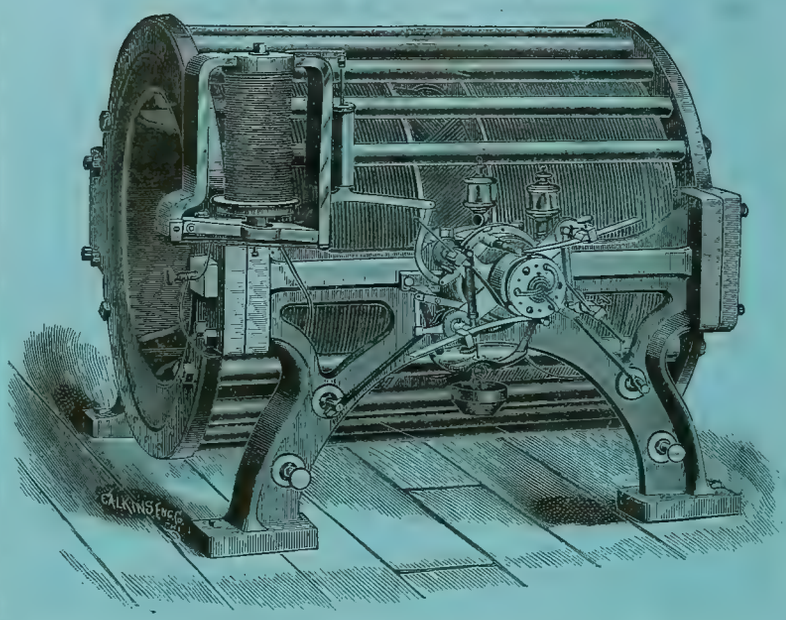

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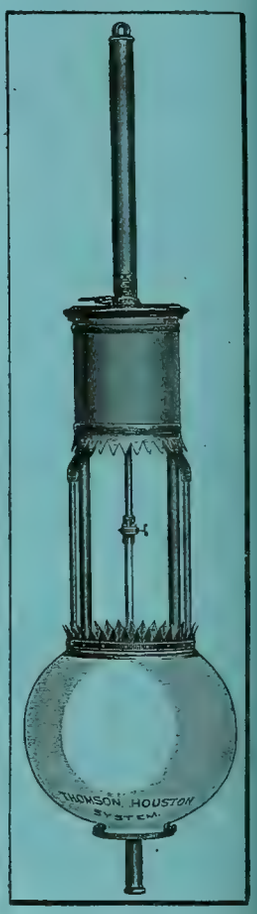

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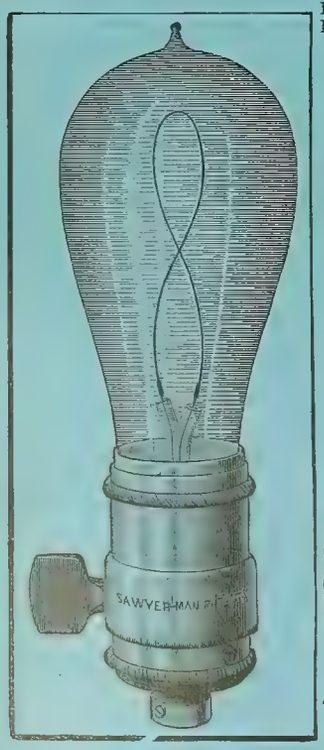
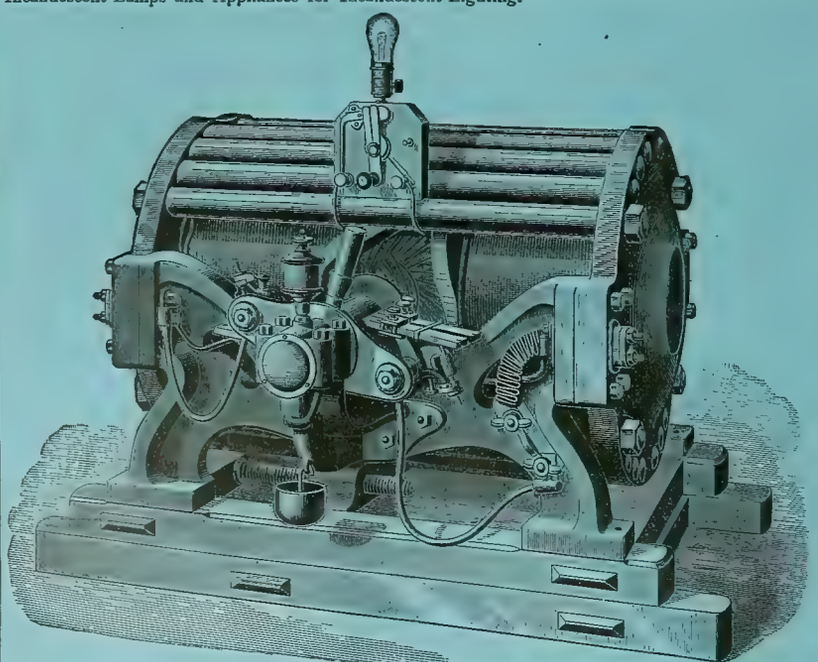
These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

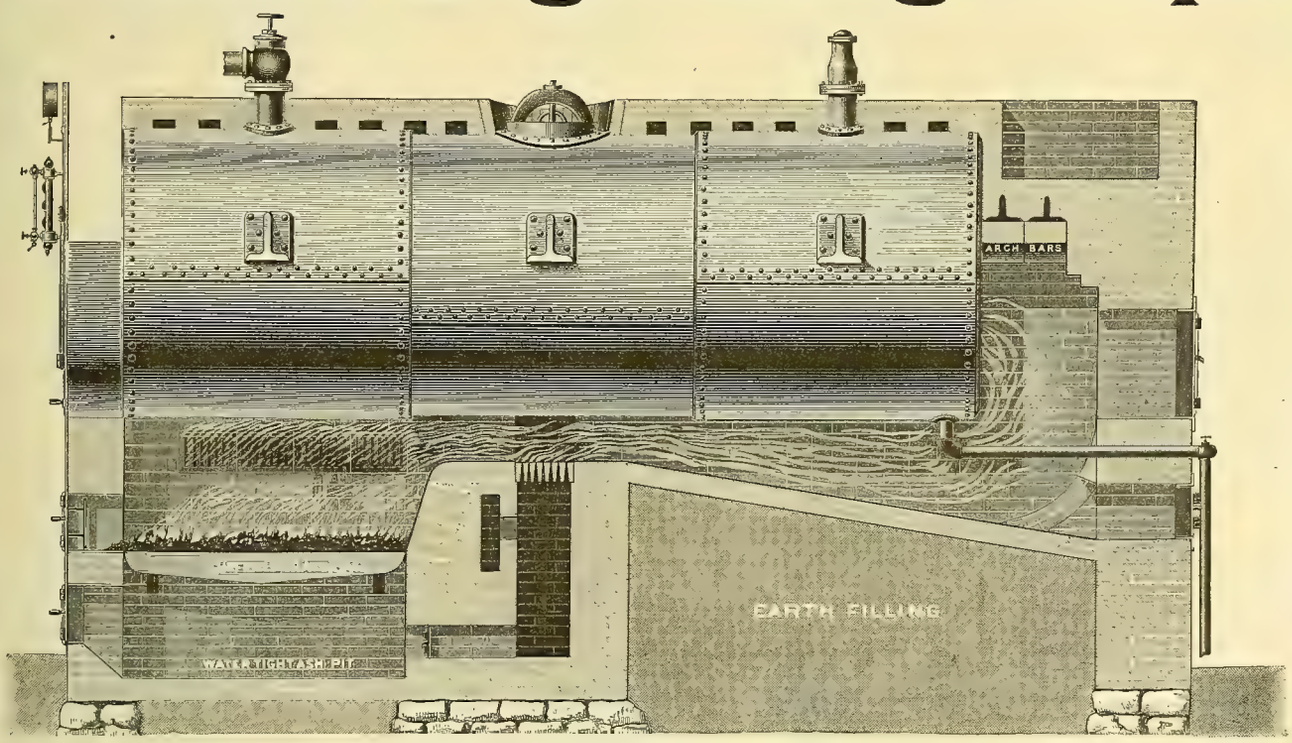
AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

K. M. JARVIS, President. J. A. GRANT, Secretary. A. F. UPTON, Treasurer and General Manager.

The Jarvis Engineering Company

Engineers and Contractors.



The "Jarvis Patent Furnace" a Specialty.

Burns Slack, Screenings, Coke, Breeze, etc. Correspondence solicited. Circulars, Catalogues, and general information furnished on application.

ARE PREPARED TO FURNISH ESTIMATES AND CONTRACT FOR

COMPLETE OUTFITS OF STEAM MOTIVE POWER

For Electric Lighting Stations, Mills and Factories, including Boilers, Engines, Steam Pumps, Feed Water Heaters, Injectors Iron Stacks, Grate Bars, Boiler Furnaces, etc.

CHICAGO: 81 LAKE STREET.

BOSTON: No. 61 Oliver St. H. A. GLASIER, Mgr. Western Department. NEW YORK: No. 108 Liberty St.

THE NATIONAL CARBON CO.

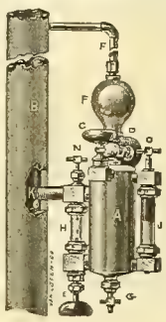
CLEVELAND, O.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

Chicago Electric Club.

There will be a meeting of the CHICAGO ELECTRIC CLUB, Monday evening, October 17, at 8 o'clock, at the rooms of the Club, 122-124 Clark Street.



The Detroit Sight Feed Lubricators

Are pronounced the best by more than 20,000 users. They are especially adapted to

HIGH SPEED ENGINES FOR ELECTRIC LIGHTING

Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

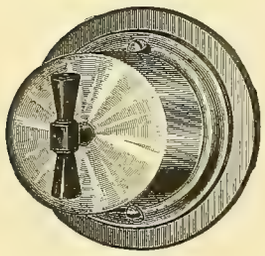
Liberal discount to the trade. Send for Circular and Price List.

DETROIT LUBRICATOR CO.

Office, 11 Rowland Street, - DETROIT, MICH.

FOREST CITY ELECTRIC WORKS,

MANUFACTURERS OF



Cleveland's Electric Light Cut-outs,

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.

Correspondence Solicited with Electric Light Companies.

W. B. CLEVELAND, Proprietor,

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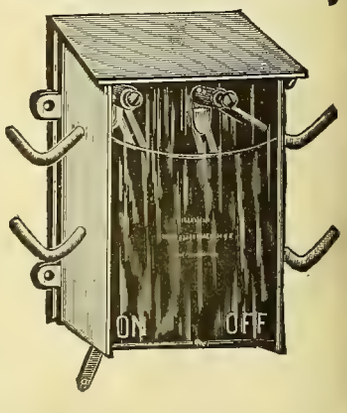
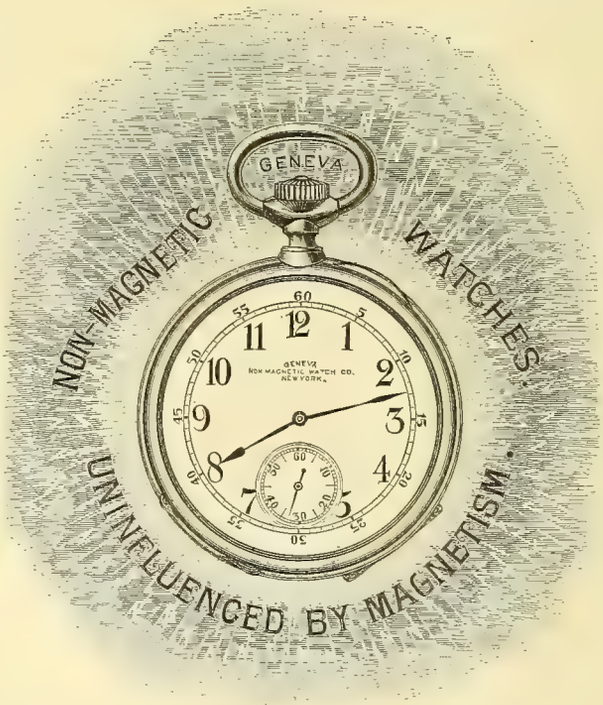


Geneva Non-Magnetic Watch Co.

(LIMITED.)

Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode.

Ask your Jeweler for them.



Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the works, they require no shield or other protection.

Send for Catalogue.

177 & 179 Broadway, New York.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS OF

Steam and Hydraulic Machinery.

Complete Steam Plants for Electric Light and Power.

Western Agents for Armington & Sims' Engines, Steel Tubular Boilers, Jarvis' Patent Furnace, National Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Jenkins' Bros. Valves, Etc. Also, Brick and Pipe Work, and Belting.

SEND FOR LATEST CATALOGUE.

707 and 709 MARKET STREET, - ST. LOUIS.

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MANUFACTURERS OF

Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

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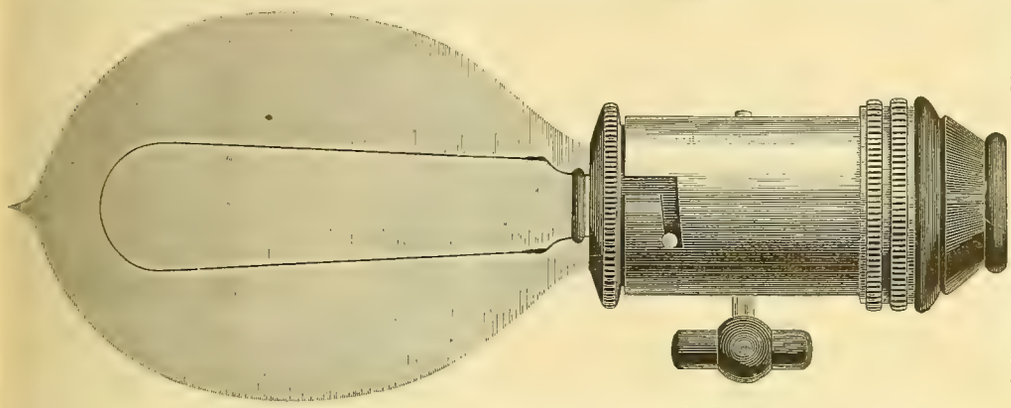


ACTUAL SIZE OF LAMP AND HOLDER (Size No. 1,) FOR LAMPS 65 to 100 V. 16 C. P.

Aluminous Incandescent.

We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

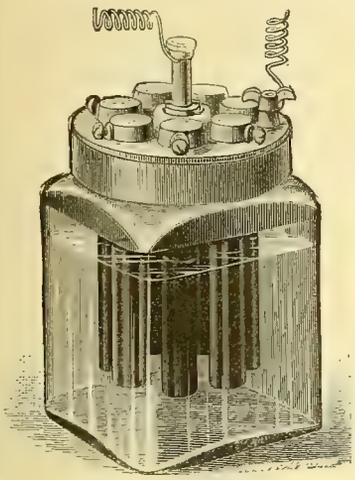
CORRESPONDENCE REQUESTED.
CATALOGUES ON APPLICATION.

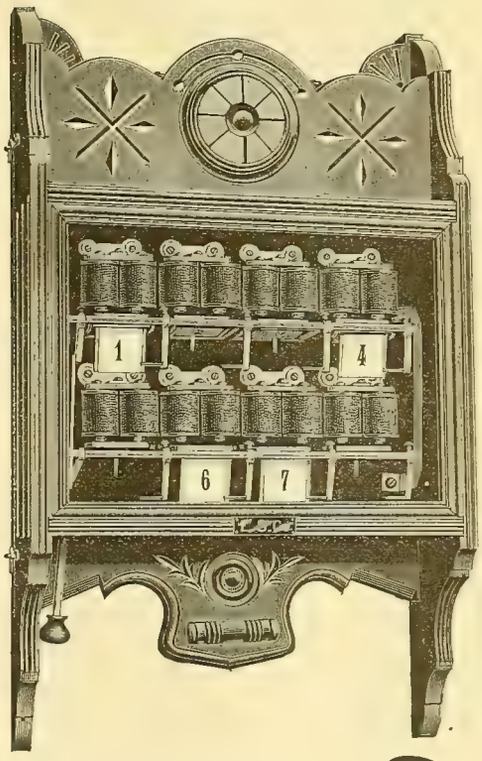
VITRITE & LUMINOID CO., 182 FULTON ST., NEW YORK.

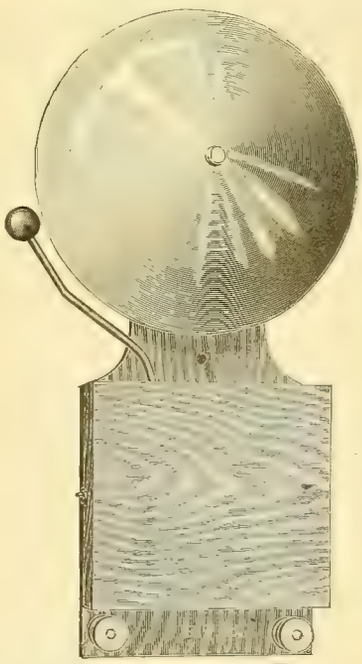
ELECTRIC HOUSE GOODS.

Annunciators, Bells, Batteries, Push Buttons.

A Large Assortment, Thoroughly Well Made.







THE ELECTRICAL SUPPLY CO.,

FACTORIES:
ANSONIA, CONN.

171 Randolph Street, CHICAGO.
17 Dey Street, NEW YORK.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

Telegraph and Telephone Apparatus and Supplies

THE BEST OF EVERYTHING AT BOTTOM PRICES.

THE EDDY ELECTRIC MANUFACTURING CO.

MANUFACTURERS OF **Automatic Electric Motors** (MATHER PATENTS.)

In all sizes from ½ H. P. upwards. The efficiency of these Motors is over 92 per cent. They require no rheostat, are perfect in regulation, simple in construction, and thoroughly and substantially built. Also manufacturers of

THE MATHER DYNAMO ELECTRIC MACHINE,

FOR ELECTRO-PLATING, ELECTROTYPING, COPPER REFINING, ETC.

These Machines cannot reverse, use no water, do not spark, and are noiseless. Satisfaction Guaranteed.

THE EDDY ELECTRIC MANUFACTURING CO., HARTFORD, CONN.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading as follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT,
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously installed by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volt.
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348.
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 600 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C. C. Warren Esq.

Dear Sir, I have written the answers opposite your questions above as far as your request, and trust they may be of benefit to you. I have been so thoroughly satisfied with your Lighting System, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.

Yours truly, J. F. Conklin

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, OCTOBER 15, 1887. No. 16.

An Electro-Mechanical Whistle.

The accompanying cut represents an electro-mechanical whistle recently invented by H. B. Cox of Fernbank, Ohio. The whistle was designed for use in connection with Mr. Cox's electric system of railway train signals to obviate the difficulties attending the use of ordinary electric gongs which were often thrown out of order or made to jingle by the motion and jar of a locomotive.

Closing the circuit energizes the electro-magnet which by attracting the armature lever operates a valve admitting steam or compressed air to the whistle. The peculiarity of the valve is that instead of a circular opening in its plug to admit the air or steam, it has an elongated slit one-eighth of an inch in width. By reason of this a very small throw of the armature lever fully opens or closes the valve and thus obtains the same result produced by the half revolution of an ordinary valve-plug. The signal is sharp, instantaneous and louder than that produced by any other electric or electro-mechanical device.

Besides the work on locomotives for which it was originally designed, it is especially adapted for use in factories. Push buttons in the office or in any part of a building can be used to give prompt signals for opening and closing the works or to give danger signals in case of fire, the breaking of machinery or upon any occasion for alarm. It is also valuable in connection with pumping engines to signal the overflow of a tank; with marine engines, when signals may be given by use of push buttons in any part of the vessel; or in any other place when it is desired to give instantaneously a sharp loud signal.

Chicago Electric Club.

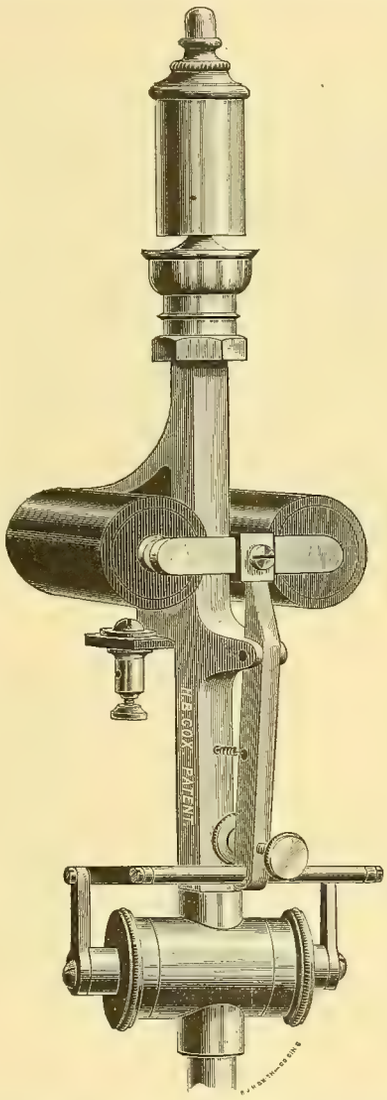
When a WESTERN ELECTRICIAN representative inspected the new quarters over 122–124 Clark street, chosen for the home of the Chicago Electric club, last Monday, it required some stretch of imagination to picture as pleasant and handsomely furnished quarters as will really be provided.

Carpenters, paper hangers, upholsterers, plumbers, painters, gas-fitters and carpet layers were all at work actively engaged in their respective occupations, or making preparations to commence as soon as the preceding workman had concluded his particular work.

The new rooms are located in the second story, exclusive of the basement, over 122–124 Clark street. A short flight of steps leads from the street to the first story and another flight carries the visitor to the floor on which the club rooms are to be found. Turning to the right at the head of the stairs the club member or visitor will find the main entrance to the large assembly room of the club. This room fronts on Clark street. It is twenty feet wide and fifty-seven feet long. In front and on the side which opens on the alley between the Chicago Opera House building and that in which the club rooms are located there are ten large windows. The length of the room admits of its being divided by curtains into three smaller apartments each having its fair share of windows; or, the portieres may be drawn to either side throwing the several apartments into one large pleasant commodious assembly hall.

Directly in rear of the main room is a smaller room intended for a well-appointed restaurant. This room leads into a hall which will be partitioned off for the benefit of the club, in reality placing at their disposal another room. At one end of the hall will be placed the dummy waiter which will be carried down into the restaurant of Lansing & Sickler in the basement of the building. Off this hall also leads the room devoted to toilet conveniences.

This, in brief, is a description of the new club rooms seen in a maze of confusion and dirt. The committee, Messrs. Buckley, Shain and W. A. Stiles have devoted a large part of the time since the last meeting in getting the new rooms ready for occupancy and they promise that though their intentions may not have been carried out in full by the time for the next meeting, yet the club will have a place for the meeting and that too, much more convenient and commodious than the room in which meetings have heretofore been held.



The next meeting will be held Monday evening, October 17th, when E. P. Warner will read a paper on "automatic current regulation." A large attendance is desired.

The newly invented lucigen light is produced by the action of compressed air on a film of waste oil. At a recent trial it is said that the smallest print could be easily read at a distance of 200 yards from the flame, and it is claimed that for outdoor work the light has no equal.

That Telephone Concession in China.

The Chinese concession granted to an American syndicate through the diplomatic negotiations of Count Mitkiewicz has lost none of its interest to the public, involving as it does what are said to be very valuable grants in the way of establishing a bank, building telegraph and telephone lines and railways. The *North China Daily News*, published at Shanghai, under date of August 11th, throws new light on the matter and predicts the eventual collapse of the scheme. It says: "Pressure was brought to bear on the Viceroy Li by the Chinese minister at Washington. Mr. Butler next appeared in China, and after a discreet interval Ma Kien Chang presented himself to introduce Count Mitkiewicz, and was followed by Sheng Taotai. The arrangements made are curious. Some of the details are as follows:

"A loan is made by the American syndicate of 2,500,000 taels (a tael is a little less than $1.40) at 3 per mil (three-tenths of 1 per cent.) per month, for five years, 3.6 per annum. The sum nominally is the Chinese portion of the capital of the new bank that is to be founded with extraordinary privileges, concessions, and immunities. The loan is made on the security of the Chinese Merchants Steam Navigation company's fleet and property, or as much of them as may not be pledged. It is possible that the Chinese telegraph administration may be also liable, but such a lien, if made would not be, as the law now stands, valid. The Chinese do not touch the money lent. The burden of the loan falls on the Chinese companies represented by Taotis Sheng and Ma. Sheng is a Taoti of Chefoo, and a great friend of the viceroy.

"The second loan is for 1,000,000 taels. It bears no interest and no term for repayment is stated. There is a mystery about this special loan. The fleet of the Chinese Merchants' Steam Navigation company will again, it is supposed, be placed sooner or latter under the flag of the United States.

"The new bank will, it is said, when in full swing, have a fund of 150,000,000 taels. It will also be a credit mobilier, and will finance and construct railways and public works, naval and military establishments, provide for coinage, emit paper money, and serve as an initiatory measure for the unification and centralization of the empire.

"It must be conceded that the scheme is vast. The extravagance of proportion is so great that the sincerity of the Chinese officials in it is suspected. The contract has been signed in the name of the Viceroy Li by the Taoti, Chon-fu. The Taotis Sheng and Ma are parties to it. The Viceroy Li has signed a letter of conditional acceptance. The letter is addressed to an American banker, who is connected with the syndicate. It is said the provincial authories will create a row. It is also said that the Chinese manager of the new bank will be Yang, formerly a secretary of the board of revenues at Pekin. He was dismissed from there and degraded. His appointment astonished the Chinese.

"From a sensible view a collapse of the scheme is inevitable. The Chinese officials are closely inquiring into the proposed scheme. The replies they receive seem to be that an imperial bank with large capital and power to emit convertible paper money under state guaranty, is not only a desirable, but has become a necessary, institution; that coinage should be unified throughout China, but that the business of coinage is proper for a special state department, and not for a bank;

coinage business, but in addition all contracts of any kind whatsoever, will inevitably be the means of inflicting a most calamitous and crushing blow that will imperil and perhaps overturn the fabric of the empire."

Studies of the Torpedo Fish.

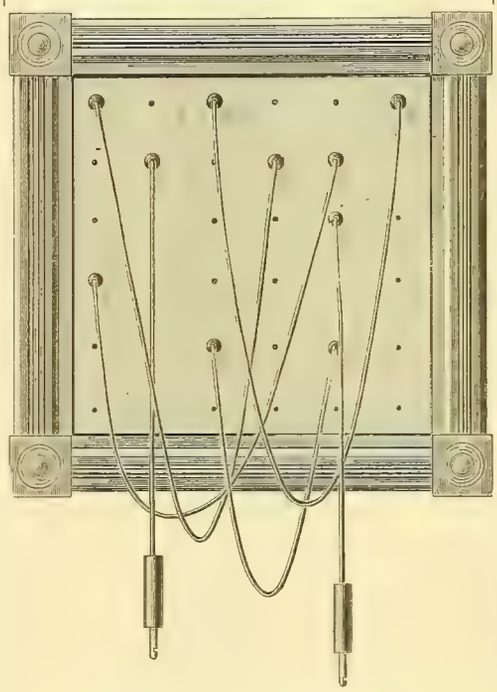
Recent anecdotes of the torpedo fish, whose habitat seems to be the southeastern waters of the Atlantic coast, have brought out some interesting studies. In its electric capabilities the torpedo fish is undoubtedly inferior to what is known in natural history as the *gymnotus electricus* or electric eel. The electric apparatus of fishes of this species provides them powerful weapons of defense. In the torpedo fish the electric organs have been compared to the voltaic pile, and consist of two series of layers of hexagonal cells, the intervening space between the plates being filled with a trembling, jelly-like substance, so that each cell can be compared to a Leyden jar. Each torpedo carries about 480 of these cells, the whole battery being equal in power to about fifteen Leyden jars, making 3,500 square inches charged to the highest degree. The upper side of the fish is positive, the lower negative, the the shocks evidently being entirely at the will of the strange electrician.

A naturalist once made some interesting experiments, one of which was the application of the telephone to a torpedo to see if the shock gave an audible sound. Such proved to be the case, a short, low croak accompanying moderate excitement, the discharge lasting about one-fifteenth of a second. When the fish was greatly excited the croak became a groan, sounding, it was said, like the tonality of mi, and occupying four or five seconds. When the attention of scientific men in England was first called to the torpedo fish, Dr. Walsh, F. R. S., amused himself and scientific London with one of these fishes, after a series of experiments at the Ile de Re. The performances took the form of piscatorial seances, and it became the rage to make a fish shock. Wondrous medical value was ascribed to it, and the demand for torpedoes brought a rich harvest to the fisherman. Their use in medicine, however, was not new, as Discorides, the physician of Antony and Cleopatra, is said to have made use of them.

Dr. Walsh's method was to place a living torpedo upon a wet towel and insulate, so to speak, his battery. Around the torpedo were eight persons standing on insulating substances. One end of the brass wire was supported by the wet towel, the other end being placed in a basin of water. The first person had a finger of one hand in this basin and a finger of the other hand in a second basin, also full of water. The second person placed a finger of one hand in this second basin and a finger of the other in a third basin. The third person did the same, and so on until a complete chain was established between the eight persons and the nine basins. Into the ninth basin the end of the second brass wire was plunged, while Dr. Walsh applied the other end to the back of the torpedo, thus establishing a complete circuit. At the moment when the experimenter touched the torpedo the eight actors in the experiment felt a sudden shock, similar in all respects to that communicated by the shock of a Leyden jar, only less intense. The torpedo was then placed upon an insulated supporter and communicated to twenty persons similarly placed from forty to fifty shocks in a minute and a half. Each effort made by the fish was accompanied by a depression of the eyes, which were slightly projecting in their natural state, and seemed to be drawn within their orbits, while the other parts of the body remained immovable. If only one of the two organs were touched, in place of a strong and sudden shock only a slight sensation was experienced — a numbness rather than a shock. The same result followed with every experiment tried. The fish was tried with a non-conducting rod, and no shock followed; glass or a rod covered with wax produced no effect; touched with metallic wire a violent shock followed. A Boston physician in making experiments with a powerful fish was several times completely floored, and when at a distance of twelve feet he struck a fish with a gig the shock was so powerful that he could not release his hold.

The Marie Hunter Case.

A case of considerable interest to the theatrical profession, that of Marie Jaeger, or Hunter—an opera singer—*vs.* the Western Union Telegraph company brought in the civil district court for the parish of Orleans, has recently been decided in favor of defendant. In stating his reasons for judgment, Judge Houston gives the main points of the case as follows: "The plaintiff brings this action to recover the sum of $1,800 damage against the defendant corporation, on the ground that it failed to deliver to her a telegram which had been sent to her to this city from New York, and which failure of the defendant corporation caused the plaintiff, who is by occupation an actress and singer, the loss of an engagement by which she would have earned the sum of $1,800. The telegram was in these words: 'New York, Dec. 2, 1884.—To Marie Hunter, Grunewald Opera house, New Orleans: Can get you leading part musical comedy, first-class manager, $60 per week. Answer quick. H. J. Cuthbert.' The evidence shows that it is the custom to deliver to the treasurer of the theater at the box office telegrams addressed to any member of a theatrical troupe when the telegrams are directed to the theater. The telegram in this case was delivered promptly to J. A. Howe, acting manager or assistant manager of the troupe with which Miss Hunter was then engaged, and the delivery was made to Howe in the presence of Stewart, the treasurer of the theater, and



to the knowledge of Stewart, the treasurer, who gave Howe a lead pencil from the box office with which to sign the receipt. The telegram was not actually handed to the plaintiff until the 4th of December. A delivery to the acting manager or assistant manager of the troupe in the presence of the treasurer of the theater, with the knowledge of the treasurer of the theater, and at the box office, was equivalent to a delivery to the treasurer himself in the box office. The company could have done no more than it did. No address was given other than that of the Grunewald Opera house, New Orleans. The messenger of the company could not be expected to wait all day at the opera house till the arrival there of Miss Hunter. He could deliver it only to the treasurer of the theater, or some one representing the opera house. The delay of Messrs. Stewart and J. A. Howe in delivering the message to the plaintiff is not a fault imputable to the telegraph company. Judgment for defendant with costs."

Electric Light Switch Board.

The cut on this page shows the style of electric light switch board made by the Western Electric company of Chicago. The construction is such that an attendant may switch together any number of circuits or dynamos or any dynamo on any circuit; at the same time he is protected from contact with the conductor and thus avoids all possibility of a shock.

A Monster War Ship.

The Trafalgar, the largest war ship ever built in England, is a steel twin screw turret ram of 11,940 tons displacement. She is 345 feet long and 73 feet broad, or 25 feet longer and 2 feet narrower than the Inflexible, and when completed and carrying her stores, crew, and armament she will draw 27½ feet of water, or more than 2 feet more than the Inflexible. Yet, monster though the Trafalgar is, she is very considerably smaller than some of the new Italian war vessels. There is, for example, the Sardegna, which is of 13,640 tons displacement, and is 410 feet long and 76 feet 9 inches broad. The British ship will, however, be undoubtedly the more serviceable craft of the two, seeing that, while she is very heavily armored along the water line, the Italian vessel's water line is entirely unprotected. The Trafalgar's armor is not yet all put on. When the whole of it is affixed to her sides, her bulkheads, her decks, and her turrets, she will be weighted with no less than 4,230 tons of it. All the external plating is what is known as compound, that is, of iron faced with steel, the two strata forming, however, a homogeneous substance. The horizontal armor on the deck is of steel only, and is 3 inches thick.

The steam and electrical machinery of the Trafalgar will be unusually perfect. The twin screws will be driven by independent sets of triple expansion engines, and the weight of the machinery will be 1,030 tons. The crank and propeller shafting are hollow, and made of compressed steel. The diameter of the screw propellers is a little short of sixteen feet. The boilers are six in number, The ship will be fitted to steer either by hand or by steam, and the steam gear will be controllable from the chart house on the bridge, the armored pilot tower, and the light-armored conning towers, of which there will be two. The vessel will be lighted by means of 460 incandescent electric lamps, and will be fitted with 4 electric search-lights. To work these she will have three powerful dynamos. The pumps are exceptionally powerful. There will be two circulating pumps, each of which can free the ship from 1,000 tons of water an hour; and there will also be Downton's pump and steam pumping engines.

Boston Electric Club.

The Boston Electric club opened its new quarters at 66 Boylston street, Boston, Wednesday evening, October 5th, with a genuine house warming. The quarters of the club include a reception and reading room on the second floor, elegantly furnished in ash, and lighted by the Sun system, and a double room on the third floor which is used as a smoking and billiard room.

The club perfected its organization something over a month ago and now has about 150 members. The attendance of members at the house warming was, of course, large and was augmented by a number of invited guests. The Chicago Electric club wired its regrets. Among those present were members of the Boston Press club and several representative electricians from various cities. The gentlemen who looked after guests were P. H. Alexander of the Sawyer-Man Electric Light company, chairman of the house and entertainment committee, and R. F. Ross, secretary of the committee. Early in the evening, on behalf of certain members of the club, George W. Adams presented the organization a fine crayon portrait of the president, Frank Ridlon.

About 10 o'clock P. H. Alexander, who acted as toastmaster, called the assembly to order and introduced Colonel C. M. Ransom, who responded to the toast "The Boston Electric club." W. M. Callender responded for the New York Electric club, President Frank Ridlon for the National Electric club, J. S. Meredith of the *Journal* for the Boston Press club. Other toasts responded to were: "The electric telegraph," by Suel Smith, an old-time telegrapher; "The telephone," by A. H. Chapman of the New England Telephone company; "The electric light," by Professor Elihu Thomson of the Thomson-Houston company; "The electric motor," by W. J. Hammer; "Storage batteries," by Morgan Brooks. N. Lawton of the Bangor Electric Light company, Lieutenant Green and Captain Brophy also made remarks.

Electric Fire Alarm Boxes.

It is useless at this late day, when the losses by fire have become so frequent and heavy that fire insurance has ceased to be a profitable business, to advocate the value of an electric fire alarm system. A system that is absolutely certain of action and instantly indicates the location of a fire, insures the prompt and efficient service of the fire department in the extinguishment of fires, and deserves the earnest attention of city and village authorities, property owners, and the general public.

The boxes here illustrated have been designed and constructed by the United States Electric Fire Alarm company for simplicity, reliability and cheapness. The cuts, Figs. 1 and 2, represent a city box, the former with the outside door closed, the latter with the door open, showing the hook to pull down to send the alarm and location in case of fire. The automatic mechanism is mounted in an iron dust-tight case, this being mounted in an inner iron case, that also contains a signal key, bell, bell magnets, lightning arrester and a shunt switch to cut out the resistance of the magnets when not in use.

Fig. 1.

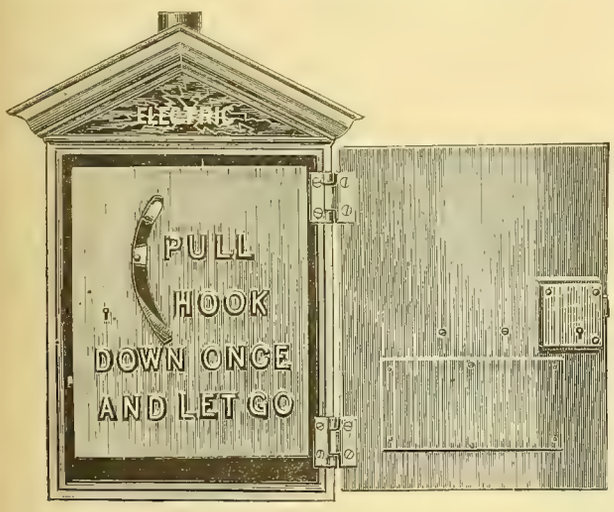


Fig. 2.

The signal key is for sending signals from the box to the engine houses, chief's residence, water works, etc.; the bell magnet and bell to receive audible signals sent from the engine houses and various places, and to notify any person about to turn in an alarm that signals or alarms are being transmitted. This second case is mounted in the outside iron box, for further protection from the weather.

In Fig. 3 is shown a smaller and less expensive box, which contains the same kind of automatic mechanism as that in the large box. Each time the hook is pulled the number of the box is struck upon all of the engine house gongs and tower bell strikers, and automatically repeated any required number of times, the number of strokes in each round corresponding with that of the number of the alarm box.

Fig. 4 represents an improved village signal box. An alarm may be sent from it for any other box in the circuit automatically, thus enabling a person sending in an alarm to send the number of the box nearest the fire, even though it be sent from another box, thereby saving valuable time necessarily taken to reach the box nearest to the fire.

From Youth to Old Age.

Mary Harmon, a girl of nineteen, a short time ago went into an electric light station in Cleveland to see the workings of the place. It appears that a broken wire of her panier or bustle had unperceived worked its way through her dress. While passing along the wire came in contact with one of the powerful electric machines, and her hand resting on an iron bar at the time completed the circuit, and she received a severe shock and fell insensible to the floor. In a few moments she revived sufficiently to be removed from the place, and was taken to her home. She was slow in recovering, and the physical effects, as reported, have been horrible. The hair on the left side of her head turned gray and began falling out. From a young handsome girl she has been transformed into a feeble old woman of hideously wrinkled countenance. The physicians claim that the electric current communicated directly with the principal nerves of the spine and the left side of the head, and that the shock almost completely destroyed their vitality. Strange to relate, the girl's eyesight is but slightly affected, but her hearing is almost totally destroyed. Notwithstanding her condition, the physicians claim that her chances for living her allotted number of years are not materially lessened, although she can never recover from her prematurely aged condition.

Important Private Telegraph Lines.

A New York press dispatch says: "While Wall street is guessing as to the sale of the Baltimore & Ohio telegraph to the Western Union, the extension of telegraph lines over the country independently of the great companies is attracting attention. A report from one of the lower counties of Michigan has just been received here. The appearance of the telephone led to a demand for something cheaper. The need was met by building ordinary telegraph lines from house to house through the county. After a while a corporation was organized with headquarters in one of the leading towns of the county. This from the report is of interest: 'The local line was first in use in September, 1882. Less than a dozen instruments were in use at first. Now over fifty instruments are in use. The lines are over thirty miles in extent, the two termini being about eighteen miles apart in a direct line. The wires are taken through farmers' houses, and the girls learn the instruments and play them with intelligence instead of the piano. The morning weather bulletins are thus brought to the farmer's breakfast table. The Morse sound instrument is used. Outsiders are charged for messages.' Other local companies are under way, and one does not have to look very far to see the day when the well populated counties of such regions as lower Michigan will be covered by a network of local wires working from one county to another. These few facts help us to understand what the near future of the telegraphic service of the country is to be. Telephone extension is, of course, to be identical. It is therefore probable that when Mr. Gould comes to sell the Western Union to the government to be added to the postoffice department there will be very many local companies like those in some of the lower counties of Michigan above reported."

In the southern central part of New York the telegraph is used in a section of considerable area in a similar manner to that stated in the dispatch. Some years ago a private telegraph line was established for the amusement of two or three young men and ladies. Others grew interested, the lines were extended, instruments were put in, and now there is a long circuit connecting villages, hamlets and isolated farm houses. The farmers' daughters have become quite expert in the use of the key and read very readily by sound. The expenses of maintenance and extension are met by assessment upon the users of the line, and amount to very little when the benefits of instant communication for either business or social purposes are considered.

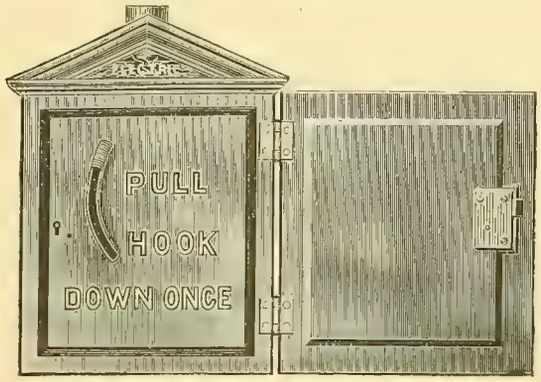


Fig. 3.

Effect of Gas upon Libraries.

At a meeting of the members of the Library association at Birmingham, Eng., C. J. Woodward read a paper in which he explained some experiments he had made as to the influence of gas on bindings. The conclusions he drew were that leather exposed to the foul air in which gas had been burning for 1,077 hours was seriously deteriorated, for the extent to which it would stretch was reduced from 10 per cent. to 5 per cent., while the strain it would bear was reduced in the ratio of 35 to 17, or about two to one. The leather exposed to a temperature of 195 degrees Fahrenheit for 1,000 hours in at atmosphere free from products of gas combustion was also deteriorated, for the extent to which it would stretch before breaking was reduced from 13 per cent. to 9 per cent., while its breaking strain was reduced from 36 to 28. A temperature of 142 degrees Fahrenheit for 1,000 hours had no marked effect upon leather.

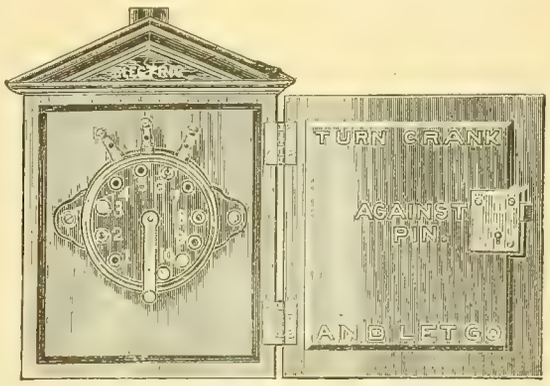


Fig. 4.

The city council of Pittsburg, Pa., has decided that telegraph and electric wires in that city must go underground in the district bounded by Eleventh and Grand streets and the Allegheny and Monongahela rivers. After November 1, 1890, no poles or wires are to be erected overhead except for terminal purposes.

Submarine Warfare.

The multiplicity of cunning inventions, either for protecting passes of water by means of submerged explosive engines or for seeking the enemy out at sea and blowing his sides in under the water line, has led to the separation of implements of submarine warfare in our own days in two classes. One comprises all passive obstructions, fixed mines, and controllable torpedoes, and the other all the mobile apparatus, towed, and spar-torpedoes and submarine vessels. It is curious to note how most of these inventions, which, being so scientific, appear so essentially modern in character, have their counterpart in the devices of past centuries. The spar torpedo-boat, for instance, was but a revival of these agile crafts, carrying on a long spar fixed on their stem cressets full of raging "Greek fire," which Marcus Græchus, in his *Liber ignium ad comburendos hostes*, written in the thirteenth century, describes as an old invention. The mobile torpedo finds its prototype in those drifting or secretly propelled infernal machines which played a noisy, if not very effective part in so many water fights, from the siege of Antwerp in 1585 to the English onslaught on Rochefort in 1809. Again, in Gianbaptista Porta's treatise "De Munitoine," the the last work, written in 1508, of that ingenious philosopher, the inventor of the camera obscura, and of so many physical appliances supposed to belong exclusively to this age, we read a very circumstantial description of fixed submarine mines. This branch of harbor fortifications likewise engaged the attention of many engineers and physicists before its alleged invention by Bushnell and Fulton. On this subject the supposed inventors of mechanical mines can not be held to have originated anything but a more perfect firing. We even find from very early times the main idea of the submarine vessel, as employed for naval purposes, pervading a long series of contrivances destined to supersede the employment of professed divers for conveying submerged fiery or explosible contrivances under the bottoms of ships. In the days of James I. the learned Dr. Cornelius van Drebbel seems to have constructed a tolerably efficient submarine vessel, which could carry at the end of a spar a mechanically explosible powder charge. The elaboration of really practical crafts of this kind has been assiduously attempted at various times since, and Mr. Nordenfeldt's vessel or the American Peacemaker can only be regarded as the result of modern scientific discoveries applied to a very old idea.

But however ancient the idea of submarine warfare may be, its systematic application belongs to the second half of this century. It is said that Louis XIV. discouraged all attempts at its development on the canting plea of its disloyal character, but obviously because he felt himself sufficiently powerful on the sea It was for a similar reason that Fulton's really very efficient machines were discouraged first by Napoleon, and then by our own government. The French emperor considered that such methods of warfare, if seriously countenanced, would favor the art of defense in a manner which did not suit his aggressive policy. In England, on the other hand, public opinion about torpedoes was fairly represented by the words Lord St. Vincent is reported to have pronounced after the celebrated experiment off Walmer castle, in 1800, when the brig Dorothea was successfully blown up by a drifting torpedo. "Pitt is a fool," he bluntly remarked to Fulton himself, "for encouraging a mode of warfare which, if successful, would wrest the trident from those who claim to bear it as their sceptor of supremacy on the ocean." And so, after having vainly attempted to help the French blow up the English and the English to blow up the French, Fulton, thoroughly disgusted, returned to America, where, although it did not meet with the consistent help he expected, his invention seems to have been utilized to a certain extent by his countrymen in the conflict of 1812–13. The idea fructified in the new world, especially after Samuel Colt had generalized the application of electricity to the firing of mines—an invention, by the way, which the French claim for one Gillot—and devised his "reflector," the prototype of many of the more perfect methods of watching and working a mine field.—*London Saturday Review.*

Newspaper Reports by Telephone.

The *Daily News*, of Chicago, tells in an interesting way the *modus operandi* of securing its base ball reports from the base ball park, and not only publishing them within a few seconds after the game was closed, but doing the work with such rapidity that printed copies of the paper were offered for sale at the gate of the park before all the spectators had left. The feat is a great one, and can best be appreciated by those familiar with the workings of a newspaper office. On top of the grand stand at the base ball park was built a little building which accommodated two reporters, one of whom watched the game through a peep hole, and who reported the features to the other. The other reporter stood at a telephone, and his work was to paraphrase "'Anson–home run–Congress street' into some such Addisonian language as this: 'Then Capt. Anson, with a mighty lunge, hurled his bat against an out-curve and the ball rose in a sightly parabola and, describing Hogarth's line of beauty, descended beyond the Congress street wall.'" The other end of the telephone line was in the *News'* editorial room. A reporter held the receiver and repeated to a rapid type writer operator the foregoing and other similar Addisonian phrases descriptive of the game. From the type writer the copy, sheet by sheet, was taken to the composing room. Ordinarily six innings of the game were described in detail, as it would be out of the question to describe the entire nine innings in full and get the papers on the street at a seasonable hour. Consequently, when the description of the six innings was in type, the forms were rushed to the stereotyping room and the plates cast. The plates were then put on the press with blanks in the places in the "score by innings" not filled in by type. There was another telephone in the press room, and this was put in connection with that at the base ball park. "Two men are out in the last half of the ninth. The base ball reporter telephones the balls and strikes on the last man, and the man at the telephone repeats them to the man beside the press, so that he may be ready. 'Four balls; three strikes. Three out.' The man besides the press bends with the swiftness of an adder, makes a figure where there was a blank in the plate, the pressman gives the lever a mighty yank, and before the last shout at the park has died away the big press is ripping out 'extras' at the rate of

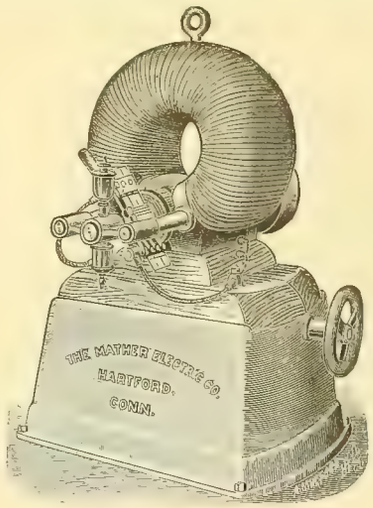


Fig. 37.

24,000 an hour." In thirty seconds after the game was concluded papers were sold on the street, and as rapidly as a horse could travel a batch of papers was carried to the park for sale among the spectators.

A Handsome Contract.

The contract for lighting the union depot and offices on the west side, Chicago, was awarded to the Thomson-Houston Electric company October 7th. The contract calls for 60 arc lights, and 850 incandescent lights. Inasmuch as there was considerable of a struggle among electric lighting companies to secure this handsome contract, the Thomson Houston company is the more to be congratulated upon securing it.

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number XIII.

The Ball Dynamo.—This dynamo, on account of its peculiar construction, is designated as unipolar. This construction will be readily understood from Fig. 36. A wrought iron frame consisting of two end plates connected by four cylindric bars supports the machine. The bars constitute the cores of the field magnets, are yoked together by the end plates, and wound with number 14 wire.

The armature consists of two Pacinotti-Gramme rings, constructed in the usual manner, and wound with number 16 wire; these are mounted

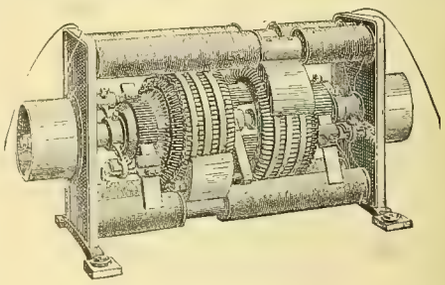


Fig. 36.

on a shaft supported at the ends and center, and terminating in two band wheels, either of which may be used, according to convenience. The two armature rings are magnetically insulated from each other at the center by a brass connection in the shaft, and each is furnished with a separate commutator, placed near the opposite ends of the shaft. In proximity with each armature ring is placed a single wrought iron pole-piece—one below at the left, and the other above at the right as shown. Two brushes press lightly on each commutator, the current entering by one pair and leaving by the other pair.

The leading advantages claimed for this construction are: First, that by the distribution of the armature coils over two rings instead of one, their reduced thickness brings the cores closer to the pole-pieces, the mass of wire in the coils closer to the cores, and thus increases the reciprocal magnetic and electric action, while reducing the liability to magnetic saturation of the cores; thus securing the full magnetic effect with less molecular strain on the cores, and consequently less heating; secondly, the openness of structure resulting from single pole-pieces and reduced thickness of the coils increases the ventilation and reduces the heat accumulation. The minor advantages are high efficiency in proportion to amount of material and cost of construction; facility in setting up and taking down the machine, or removing the various parts for repair or renewal; and freedom from complicated mechanism.

The lightning arrester is also an adjunct, and the automatic movement of the brushes on the commutator can be applied but is not recommended. By making the pressure of the brushes light, sparking is said to be reduced as well as wear of the brushes and commutator.

The Mather Dynamo.—This dynamo, designed exclusively for incandescent lighting, and illustrated by Fig. 37, is distinguished chiefly by the peculiar form of its field magnet. The core and pole-pieces are one single casting, in almost the exact form of a horse-shoe, as shown in Fig. 38, all joints being thus eliminated, and perfect magnetic continuity secured. It is wound in two circuits, a shunt of medium size wire lying next the core, and the main circuit of heavier wire on the outside. Two cylindric wrought iron bars extend through the two pole-pieces and are connected at each end by brass yokes which support the armature and insulate it magnetically from the field magnets, as shown in Figs. 37 and 39.

The armature, shown in Fig. 39, is of the drum type, similar to the Edison, and without interior ventilation. The core is composed of sheet iron rings, on which the coils are wound longitudinally, in one closed circuit, and connected to the commutator by radial arms in the usual manner.

The two circuits of the field magnets are con-

nected with two binding posts, one of which is seen in Fig. 37 at the upper right hand corner of the base; the other, on the left, being hid behind the drip cup; these posts being connected with the brush-holders as shown. The main circuit connects with the binding posts beneath the base, and one end of the shunt connects with the right hand post as shown; the other end, on the left, being connected with a rheostat attached to the wall, and containing a number of resistance coils; and from this a wire leads to the left post; so that the rheostat is thus placed in the shunt circuit, the lamps being in the main circuit. By the movement of a switch in the rheostat, a greater or less number of resistance coils may be included in the shunt, and the resistance varied to any desired extent; the volume of current in the lamp circuit, varying inversely

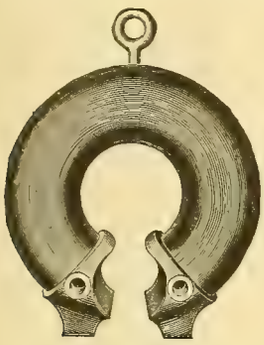


Fig. 38.

as the resistance in the shunt, may thus be increased or diminished as required for a greater or less number of lamps; and both circuits being connected with the brushes, it is evident that the current from both circulates through the armature.

The machine is mounted on an elevated cast iron base, from which it is insulated by a wooden base, which slides between flanges and is moved by the adjusting screw, shown at the right, to regulate the tension of the belt.

Answers to Electrical Problems.

To the Editor of Western Electrician:

In number 4 of the Western Electrician, I noticed a series of very interesting electrical problems which I have been hoping to see answered, but as no one has yet seen fit to tackle them I will attempt to answer some of them, where a simple process of reasoning will meet the requirements, leaving to others, who are better supplied with the necessary apparatus, the task of answering those which require accurate tests.

Problem 1, represents a line with a ground connection at both ends, a battery of 100 volts near one end, a rheostat of 100 ohms resistance in the center, two condensers *a* and *b* placed between the battery and the rheostat; condenser *a* of two farads capacity, next the battery, and condenser *b*, of ten farads capacity next the rheostat; while in the other half of the line are placed the two condensers *c* and *d* of ten farads each, between the rheostat and ground; the line being without practical resistance, and the rate of flow one ampère, as shown by the e. m. f. and resistance. Now since the positive current of the battery must traverse the rheostat and the four condensers to reach the ground, passing first through the two-farad condenser *a*, then through the first ten-farad condenser *b*, then through the rheostat, and lastly through the two ten-farad condensers *c* and *d*, the following queries arise:

1. Will condensers *b*, *c* and *d* (ten farads), each contain the same charge as *a* (two farads), when *a* is fully charged?

2. Will the potentials then be the same in all? If not, what is the potential on each one?

3. Will the rate of flow when charging and discharging be the same over each connecting wire in the series that it is between *b* and *c*?

4. Will all the condensers become charged at the same time?

5. Will the current have the same volume and the same e. m. f. over each connecting wire?

6. Will it be so if the rheostat is removed?

7. Is this formulæ correct for the capacity of this series:

$$C=\frac{1}{\frac{1}{2}+\frac{1}{10}+\frac{1}{10}+\frac{1}{10}}=\frac{10}{8}F?$$

Answer to No. 1: The flow through condensers is by induction; the negative charge on the ground side is always exactly the same as the positive charge on the battery side, consequently when condenser *a* is positively charged to its full capacity, two farads, its negative charge will also be two farads; and the electricity repelled from the negative, or ground side, passes on to condenser *b*, which thus receives a positive charge of two farads on its battery side and an equal negative charge on its ground side. In like manner *c* and *d* become charged to the amount of two farads each, the negative charge of two farads from *d* passing to the earth. Hence as *b*, *c* and *d* receive their respective charges through *a* they can not become more fully charged than *a*, no matter what their capacity may be.

Answer to No. 2: As the charge is the same in each, the potential of each, as a whole, must be the same.

Answer to No. 3: The placing of the rheostat between *b c* cannot make the rate of flow different on this section of the line from what it is on any other section; the current flows from the battery to the ground through the rheostat and must be the same on all parts of the line.

Answer to No. 4: The outflow at the ground end must take place at the same moment as the inflow at the battery end, as there can be no inflow without a corresponding outflow, hence all the condensers must become charged at the same time.

Answer to No. 5: The potential and rate of flow being the same, the volume and e. m. f. must be the same over each connecting wire.

Answer to No. 6: A current impelled by an e. m. f. of 100 volts through a resistance of 100 ohms will have a volume of one ampère, $C=\frac{100\,E}{100\,R}=1$ ampère, but if 100 R is suppressed, we have $C=100\,E=100$ ampères; hence the e. m. f. remains the same, but the volume of current, according to Ohm's law, becomes 100 ampères.

Answer to No. 7: The capacity of the series, as arranged, cannot equal the added capacity of the several elements considered separately, since the capacity of *b*, *c* and *d* can never rise higher than that of *a*, as shown in the answer to No. 1, consequently the formulæ is not correct. Zeta.

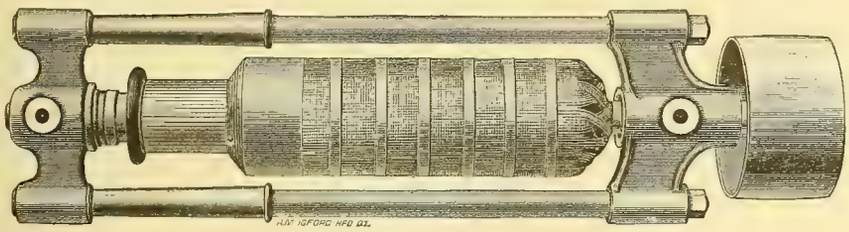


Fig. 39.

In Mr. Barclay's paper on "Why electric light companies should distribute and sell power" published last week, the first paragraph in the third column, page 173 contains a statement that a certain electric light station had 103 horse power in motors installed, the actual amount contracted to be delivered was 32 horse power and the maximum amount of steam power they had been called upon to supply was 40 horse power. The amount contracted to be delivered should have read 82 horse power.

Electric Motors vs. Steam Engines.

To the Editor of Western Electrician:

In an editorial in your issue of October 8th, answering inquiries from correspondents as to the character of electric motors, and the inquiry whether a motor would be cheaper than a steam engine, we are afraid the explanations are not clear enough and are apt to mislead electricians and electric business men, as well as users of power.

In the first place, on moderately small engines, say of 25 or 30 horse power, it is found cheaper to use electric power than to generate steam power individually. Witness the large amount of electric power now being distributed in cities and the statement of the users that it is as cheap and, many state, when taking the matter of convenience into consideration, it is decidedly cheaper than steam power.

Again, you say "the power actually utilized may not exceed 40 to 50 per cent. of the power generated," which means that the other 60 or 50 per cent, is taken up in loss in transmission and conversion. This statement is correct if you had qualified it by saying "over long distances or where the source of power costs but little." To illustrate: Assuming 200 horse power in water and 100 horse power being required for actual work a number of miles off. In this case, it would probably be cheaper to lose 50 per cent. in transmission, but in ordinary cases of distribution in towns, the recovery in actual practice on the pulley of the motor is 65 to 75 per cent.

Further on you say, "hence, it is cheaper to use the power direct from the engine or water wheel when possible, than to transform and transfer by means of electricity." To that statement we beg to take exception. It is not always the most economical to use the power direct from the engine or water wheel, as the following statement will show: An engineer made a test of eight New England cotton mills, and found that the average loss in the eight mills was over 30 per cent. in the lines of shafting alone before the delivery of any power for work, and in one case, where the horse power required for the whole load was 670, the horse power used for shafting alone was 262, or 39 per cent. Thus, if electric power was distributed in several units to different parts of the mill, the constant load of shafting would be avoided. The advantages of using the power at or near the work done, which is available by electricity, does away with the constant load, which is enormous when the shafting is of considerable length, or when angles have to turned, or in groups of buildings from one source of supply. In electrical transmission, the loss is always a fixed per cent of the total power, whether it be large or small, thus securing a much greater economy where power to be supplied is variable.

You say again, "if the time ever comes when the heat of the furnace can be converted at once into electricity, the engine can then be dispensed with and the motor take its place." In reply to that, we would say that we do not require to wait until then for the motor to take its place, for it is now taking the place of engines in hundreds of cases, with the result that the engines are still used as prime generators of power but in larger units, admitting of a general average in distribution, consequently less cost in production than in a number of units or small engines, where the general average and intermittent use would not come into play.

C. M. Barclay,
Western Office, Sprague Electric Ry. & M. Co.

Chicago, Oct. 10, 1887.

Reinforcing Electrical Contacts.

Before the British association at Manchester, Eng., in September, E. W. Serrell, jr., of New York, explained a method of securing a good electric contact under circumstances in which ordinary solid or mercury contacts will not work. The method consists in the use of a sucking coil or small electro-magnet, placed near the contact and traversed by the whole or a part of the current when the circuit is closed. When the contacts touch, no matter how lightly or imperfectly, the magnet or coil is excited and acts on an armature in such manner as to cause the parts of the contact to be drawn more firmly together and to scrape over one another so as to be cleaned by a mechanical action produced by the current itself every time that contact is made. By this method all the difficulties commonly experienced in the use of electric contacts may be overcome. If the parts are made to touch even in the slightest degree, a thoroughly good contact is instantly secured. The method is applicable to signaling apparatus and many other purposes, and is already used with success by the inventor in automatic machinery for reeling silk from the cocoon. By its use contacts have worked reliably for very long periods, under circumstances which would give rise to insuperable difficulties without it. The use of electrical appliances for reeling silk is greatly facilitated by the employment of this device, and is leading to important results; and the inventor considers that, as by this means a perfectly reliable contact is easily obtained, the use of electricity for controlling textile and other machinery may be very greatly and advantageously extended, expecially in all cases in which light contacts must be used.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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IT is announced that Solicitor-general Jenks on behalf of the government will ask the United States supreme court to advance for immediate consideration the telephone suits appealed from the supreme court of Massachusetts.

THE association of North American railroad superintendents met in annual session in New York, October 10th. Reforms in the present method of car heating and lighting were discussed, and the experiments of telegraphing from moving trains were also considered.

THE Russian government has ordered that electric lighting shall be compulsory upon all passenger trains upon the principal railway lines. The minister of ways of communication has appointed a special commission to select the best system, and the experiments will be conducted upon the Nicolaieff railway.

THE committee of the New York legislature appointed to investigate the affairs of telephone companies in that state will meet in Rochester, N. Y., on the 18th inst. Sessions will be held in the mayor's office. As the subscribers in that city hung up their receivers and plugged out their instruments eleven months ago and have not since used them, the sessions will undoubtedly be well attended.

THAT telephone concession in China, which has had the attention of the commercial world for some months past, and concerning which we reprint a statement from a paper published in the Chinese empire, it is now said, has been withdrawn, and the statements made carry the conviction that they are not altogether baseless. On the other hand Count Mitkiewicz strongly denies any allegation that the concession has been withdrawn or that it is worthless.

According to a recent paper by J. Brown, communicated to the Royal society by Lord Rayleigh, the difference of potential near two metals in contact is due to the chemical action of a film of condensed gas or vapor on their surfaces. Such a pair of metals is similar to a galvanic cell with its electrolyte divided by a diaphragm of air or other gas, and it is the difference of potential of the film that is measured in contact electricity experiments, the metals themselves being at one potential.

THE extremes of modern preparations for warfare are well illustrated in the article, published in the last issue, describing the deadly dynamite gun and in the article published this week describing the most powerful war vessel ever built for the English navy. On the one hand a long slim gun of comparatively light weight that works utter destruction through the medium of a dynamite bomb with its electric fuse. On the other hand a massive vessel fortified with a well-nigh impenetrable armor of steel and iron, and calculated to be capable of resisting the heaviest shot. The circumstances of a collision between a bomb discharged from the dynamite gun and this huge floating mass of steel and iron recall the reply to that threadbare query "if an irresistible body meets an immovable body, what will be the result." The odds, however, will undoubtedly be in favor of the dynamite gun. "In times of peace, prepare for war" is an injunction that is more closely followed by European nations than America. Nevertheless America with a navy of light swift cruisers armed with dynamite guns would be well prepared to resist any attacks on her coast.

WE conclude this week Mr. Reckenzaun's interesting and valuable paper on "Electrical street cars, with special reference to methods of gearing," read before the American Institute of Electrical Engineers. The title of the paper so fully covers the text that it is almost needless to add that its character is more mechanical than electrical. The important function of the engineer in properly applying the power developed by the electrician is strikingly exemplified in connection with the subject of gearing, and the clearness of style and evident mastery of the subject shown by the writer, have bespoken for his paper an attentive perusal.

A careful reading of the paper deepens the impression gained in its preface, that the necessity for laying aside the horse car at the earliest practicable moment is imperative. For the past thirty years it has served a useful purpose and been a great public convenience; but if the dumb horse could have spoken with man's voice and told the suffering inflicted on him, animal power would long since have been replaced by mechanical power. The reduction of the average life of the street railway horse to four years, and the annual sacrifice of 20,000 animals in this cruel service in the United States are appalling facts, which have long appealed to the exchequer of corporations, if not to their humanity.

With the facts of availability and economy of the electric motor before them, street car companies should not long hesitate about the substitution of electric for animal power.

OCTOBER 6th an event anticipated in commercial circles took shape in the consummation of the sale of the Baltimore and Ohio telegraph company property to the Western Union Telegraph company. The consideration was $5,000,000, par value, of Western Union stock. This price is just about one-half of what the property cost. The two systems will be blended as far as possible in the interests of economy, but it is said that rates will not be materially advanced, except between competitive points where tariffs have suffered most, the policy being to keep rates at such figures that no new competition will be invited.

Perhaps there is much that is true in the statement of the policy of the company. The people have been educated for several years past to low rates for telegraphing, and any attempt to force high or excessive rates on them would doubtless result in driving them quickly back to the use of the mails instead of the wires. An invitation to competition is much more readily accepted in these days than it would have been years ago. A comparatively small capital is required to build telegraph lines connecting principal cities between which the bulk of the telegraph business is transacted, and the restoration or establishment of a high tariff would be a direct bid for another telegraph company to enter the field and stay in it long enough to make its presence felt on the receipts of its great rival, and then be bought out.

It is calculated that with the issue of the $5,000,000 new stock to complete the purchase, and more to capitalize the surplus of the company, the capital stock of the Western Union company will be increased to $86,250,000. The fixed charges of the company will be increased by $60,000 yearly rental paid by the Baltimore and Ohio Telegraph company to its namesake, the railroad, for the use of the railroad lines, and assuming that dividends are continued at the rate now prevailing, the dividend account will be increased by $200,000 a year, making the total charges of the acquisition $260,000.

"UNDOUBTEDLY the meetings of the electric light convention in America fulfill an object which it seems to us we in England should strive after. We have nothing of a similar character connected with electrical engineering, and certainly an attempt should be made to bring practical men together occasionally to talk over the practice of their profession. The scientific value of the papers read by our friends on the other side may sometimes be represented by a negative quantity, but the utility of the papers and the meeting is that, from beginning to end, the aim is to further business by discussing practical questions; and when practical men will discuss their successes and their failures, good must assuredly ensue. What do our English practical men say? Shall we take the work in hand, initiate a working committee, call a meeting and test the scheme, or let it drop?"

These are words in which *London Electrician* recognizes the value of the meeting of practical men to discuss practical subjects in the line of electrical engineering and urges the formation of a similar organization in England. While the scientific value of papers presented may sometimes be represented by a negative quantity, no small part of the best electrical literature of the day emanates from that same electric light convention or from that source derives its inspiration. And when acknowledged leaders in electrical thought and electrical application avowedly attend the meeting of the association "to learn something" and are close readers of the printed proceedings of the conventions, the value of the meetings is conclusively proved.

We wish our contemporary success in its endeavors to promote a similar organization the other side of the water to that in America.

MR. BARCLAY'S exceptions to an editorial note published last week in a communication in another column would seem to call for a fuller explanation of a matter that was deemed to be clearly and succinctly stated.

It is, of course, well understood by electricians, that in towns and cities where the patronage is sufficient to justify the installment of a central electric plant with large engines to generate the power, and dynamos, distributing mains and motors to convert and transfer it electrically to users, it is far cheaper and more convenient for small factories, printing offices, and numerous other establishments, to rent the power thus supplied than to purchase and maintain an engine. It is equally true that in large factories, where the different departments are remote from the engine, requiring shafting and belting to make connection, the transfer may be made more conveniently and economically by means of the dynamo and motor. But our correspondent should remember that to the intelligent business man having a mill or factory in a remote country district, these facts are not so apparent as to the electrical expert; and having heard of the motor he often makes the mistake of supposing that it is the original source of power instead of a convenient and economical method of applying it.

If our correspondent will refer again to the editorial he will find that we stated expressly and plainly that "the loss from resistance of the conductor depends on its size and the distance to which the power is conveyed," and that "the loss with the best arrangement is 15 to 20 per cent." and that "the power utilized may not exceed 40 or 50 per cent." That is, a minimum of 40 per cent. and a maximum of 85 per cent. power may be utilized, which substantially agrees with our correspondent's minimum of 50 per cent. and maximum of 75 per cent.

We are glad to emphasize our correspondent's statement that the motor "is now taking the place of engines in hundreds of cases," and when the time comes for "direct conversion" of heat into electricity, and then into power without the intervention of steam, the present useful sphere of the motor will be so far extended as to exceed that of the engine, if it does not entirely supersede it.

Electric Street Cars, With Special Reference to Methods of Gearing.[1]

BY A. RECKENZAUN C. E.

PART III.

CHAIN GEARING.—The second car on the Lichterfeld tramway, which, by the way, must be regarded as the oldest line in the world as far as continuous successful operation is concerned, has chain gearing. The motor shaft is provided with a small toothed wheel, and one of the axles carries a large wheel with teeth to correspond to the gaps in the pitch chain links. This mode of transmission causes some noise and vibration, and this car runs slower than the other with the same amount of energy. This is accounted for by the greater friction on the surface of the teeth, as well as by the bending and unbending of the link joints; there is, besides, a constant probability of the comparatively heavy chain being thrown off tangentially by centrifugal force. But this kind of gearing furnishes an absolute or positive motion, which cannot be relied on by methods depending upon frictional adhesion alone.

Some four years ago I applied two pitch chains, four toothed wheels and countershaft for propelling a heavy storage battery car in London. The chains were of steel and substantially made; the wheels of phosphor bronze correctly shaped. I found that the chain on the fast running, first-motion shaft, rattled considerably. This chain stretched a little, when the links began to ride upon the points of the teeth, and eventually broke the teeth of the small wheel on the armature shaft. Previous to that I employed some other gear, which will be mentioned shortly.

Mr. Trail, the manager of the Portrush electric railway in Ireland, has been more fortunate than I with chain gear, but he is not perfectly satisfied, and he is now experimenting with something else. Pitch chains are also used on the Bessbrook-Newry electric railway and on the Ryde Pier cars. Mr. Holroyd Smith adopted this mode of transmission on the first cars at Blackpool, in England, but he has since changed it to worm gearing, with which he is better satisfied.

CONICAL DISKS AND CHAINS—About five years ago I had the idea that it might be advantageous to vary the speed of a car mechanically without interfering with the motor or even the supply circuit. I took out a patent for this in 1882, and applied it to the propulsion of a large street car. The motor was carried by a frame supported upon the axles by bearings and springs, to counteract the effects of vibration. By this arrangement the whole apparatus was rendered independent of the car body, and it could be easily detached. The speed pulleys consisted of conical disks, which, when placed face to face on a shaft, each pair formed between them a grooved pulley, and by shifting these disks on the shaft toward or from each other, the said groove could be made wider or narrower, as desired. Two pairs of disks on different shafts were connected by means of a chain, the links of which were surrounded by wedge-shaped pieces of leather. The cross section of this chain band was thus shaped in order to fit it into the V-grooves offered by the cones. When the said disks were pressed closely together, then the band assumed a position near the circumference of the disk, but when the latter were separated, then the groove widened, the band changed its position and ran on some portion of the conical surfaces nearer the center of the pulley. Thus the effective or acting diameter of the first motion pulley was varied at will by pressure, and the cones on the second motion shaft followed suit automatically, because the length of the band was constant, and the second pair of cones was pressed together by a strong spring. This arrangement looked very nice, but efficiency was low; there was a great waste of power through friction, and we finally abandoned it. It worked silently; it was strong and took up little room. The band slipped often when the car was starting or mounting an incline.

STRAPS AND PULLEYS.—Mr. Volk, of Brighton, England, employs leather link belts with great success, for transmitting the power of the motor to the car axle. This railway has been in operation since August, 1883. Mr. Volk tried first, single leather belts, but they broke every day or two; then he used double belts with little better results, and some three years ago he adopted the leather link belt, which has given entire satisfaction. I have seen one of the latter which has driven a car over 50,000 miles and it is not worn out yet. These belts stretch when first put on; the bearings of the countershaft are therefore made adjustable by means of a slide whereby the slack may readily be taken up. When starting the car the belts slip a little, but this is not considered a disadvantage. There are no curves on the Brighton line, and I often wonder whether this method of gearing would satisfy the terrible pull on the very sharp curves which occur on some street railways.

Mr. Van Depoele has given a high testimony in favor of link belts of a special construction after using them for a considerable time, and running them at a great velocity. Like Mr. Volk, he attaches the motor to the car body in order to give it the benefit of the existing flexibility of the car springs. Mr. Van Depoele's link belts, I understand, are made of steel, with special bearing surfaces; they have been used on a line of his construction at Windsor, in Canada; at Scranton, Pa., he employs spur gearing.

SPUR GEARING.—There exists a variety of opinions on the subject of toothed wheels in connection with electric motors, and each opinion seems based upon actual experience. I have seen spur gearing used on electric cars in Europe and in this country, and I give you freely all I know about it. The first I saw was on the Moedling line, near Vienna in Austria. The noise created there was not very great, but there was occasionally some trouble due to the untimely deterioration of the teeth. This was especially remarked by the manager of the Frankfort electric railway in Germany, which is constructed on precisely the same principles, with the difference that the former runs through a country district where there is much less traffic, and the rails are laid on the tops of transverse sleepers like a steam railroad; there is less dust and mud to contend with. Between Frankfort and Offenbach, on the other hand, the rails are laid through populated streets, whereby all the disadvantages of city traffic are brought into play. The gearing of the cars on this line is very noisy and it wears out quickly. The train of wheels consists of a pinion on the motor shaft having 17 teeth, which gears into a spur wheel of 56 teeth keyed upon a countershaft. On this countershaft is a pinion of 26 teeth and this drives a spur wheel of 52 teeth, fastened to the car axle. The velocity ratio, therefore, is as 1 to 6.6, between the motor spindle and the driven axle. The armature makes about 550 revolutions when the car travels at the rate of seven and a half miles an hour. The pinions are made of hard gun metal, and they wear out in about a month. I have seen a number of rejected pinions the teeth of which were ground into the shape of a fine wedge. The spur wheels are of cast steel and they last about ten months when in continuous service. I was surprised to see these; and what with the noise, the excessive weight and other drawbacks, it made me more than ever prejudiced against such a mode of mechanical transmission on street cars. My views on this point have, however, been somewhat modified since I have been in this country. I had the privilege of being invited to assist W. Wharton, jr., of Philadelphia, in fitting up an electric street car. There we used a set of spur gearing which was supplied by the Sprague company. In this case the motor shaft, which runs at from 500 to 600 revolutions a minute, carries two steel pinions, one at each end of the shaft, and these pinions gear direct into two cast-iron spur wheels upon the driving axle, without any intermediate wheels. The motor is partly suspended on the axle and partly on the body of the car. We have run several hundred miles with this car under all conditions of load, gradients, and weather, on some of the roughest tracks in Philadelphia, but up to this moment not a single hitch has occurred. The gearing is practically noiseless, it is efficient and strong, and I see comparatively little indication of wear. The teeth are beautifully shaped, therefore somewhat expensive, but if they last long enough, and if they do not rattle when partially worn, this expense can be ignored. This car contains, besides its usual weight, about 3,200 pounds of storage batteries; it has to mount grades of 5 per cent., and run on curves of 35 and even 25 feet radius, which means very hard work.

FRICTION GEAR. There is something quite fascinating in friction gear; it offers the advantages of simplicity, noiselessness, and theoretically a high efficiency; but as regards certainty of action and durability, it occupies a low position in the scale of appliances for the transmission of power. The late Professor Fleeming Jenkin devised an apparatus a few years ago which he called nest gearing, and of which great things were expected, and indeed it was regarded as the most perfect frictional gear ever invented.

Professor Jenkin arranged several rollers within a ring; these rollers were in contact with a central friction wheel which was attached to the motor, and the outer ring was connected to the driven object. It is well known that in a pair of frictions wheels when running together, the contact surfaces are exceedingly small, the pressure must be great, and consequently there is a rapid destruction of the said contact surfaces. Now, by placing a number of rollers within a ring, not only are the contacts multiplied, but there is a perfectly balanced pressure upon all the working parts. This kind of gearing, made of the best materials and of the finest workmanship, has been applied to the telpher line at Glynde. Its efficiency was tested and found to be somewhere near 95 per cent. In the case of telpher lines the motor and its attachments is well out of reach, suspended on tall posts, therefore dust and dirt can be absolutely excluded. The energy transmitted between the electric motor and the driving wheels averaged only 1.5 horse-power, and yet with all these advantages and the great care exercised in its construction and use, this gearing refused to act after a comparatively short space of time. The experiments were watched with intense interest by all who made mechanical science their profession, and especially by those who were seeking effective means of transmitting motion from electric motors. After a number of exhaustive tests, apparent improvements and modifications, the inventors of this nest gearing pronounced it a failure, and finally resorted to chains and cog-wheels. This fact, established after prolonged and most persistent efforts on the part of a number of the smartest mechanicians, should be a warning to all the advocates of friction gear for street car propulsion.

WORM GEARING.—Dissatisfied with the results of my early experiments I resolved to give worm gearing a trial. I collected all the data I could find in text books and from the experience of others. All the different authorities agreed on one point, and that was the efficiency, or rather the want of efficiency in worm gearing. According to various statements the loss with this mode of transmission was put down at from 33 to 75 per cent. This seemed to me a terrible waste of power; I was then, as now, engaged in the problem of utilizing storage batteries for street car propulsion. Storage batteries were at that time in disrepute generally, and as for putting these cumbersome things upon a car, the very idea of it was ridiculed by conservative-minded men. Certain would-be experts published their views on this subject, and they endeavored to prove mathematically that the battery could scarcely hold sufficient energy to propel its own weight, and that more than 50 per cent. of the power given by the charging dynamos was lost in the process of transformation. If they had known at the time that I proposed to introduce another energy-consuming apparatus in the form of worm gearing they would have declared me a lunatic. There were, however, quite a number of extenuating circumstances which encouraged me to pursue this question. I knew, from experience, that the storage battery, if properly constructed and used, could return more than seventy per cent. of the energy expended upon it; I knew also that a certain type of cell could propel several times its own weight at a speed greater than that of a horse car.

With regard to worm gearing I found that this method of transmission was used for hoists and for actuating machine tools, and that in some cases it had been working for twenty years with-

[1] Read before the American Institute of Electrical Engineers at New York, September 20th, 1887.

out requiring any expensive repairs. During all my researches I failed to discover any reliable data on the construction and use of a worm which had such a steep thread that the worm wheel could cause it to revolve. I did not come across any publication with figures to show the efficiency of gearing where the worm shaft revolved at a very high velocity whilst transmitting considerable power. Just at that time the valuable researches of Professor Thurston and Kimball and Beauchamp Tower, on the subject of friction and lubrication, were published, and these revealed the fact that all the long established laws on friction were entirely wrong. The experiments of these scientists proves conclusively that the coefficient of friction varies with the velocity, and that it decreases up to certain limits, with an increase of speed between lubricated surfaces.

Furthermore, it has been demonstrated that the coefficient of friction between lubricated bearings is not .1 or .2, as so frequently stated in text books, but .003 and less, and that even with moderately bad lubrication it amounted to only .01. All these, and other considerations encouraged me in the belief that there is a fruitful field for further investigation, and I designed a set of worm gear of the following dimensions: Steel worm, turned and polished, 6 inches in diameter, 6 inches long, treble thread of 2 inches pitch; worm wheel of phosphor bronze, trimmed teeth, $15\frac{9}{32}$ inches diameter, $3\frac{1}{2}$ inch face, 24 teeth; ratio of gear, 8 to 1. The worm was fitted to the spindle of an electric motor, and the worm wheel attached to the axle of a street car, which was supported on a frame with bearings to keep the wheels off the ground. When running empty, with the worm out of gear, the motor took 6 ampères of current, and when put in gear, but without any other load, 7.75 ampères were used to drive the apparatus at the same speed. Prony brakes were than applied to both the motor shaft and the car axle, and the power was measured on each at a given e. m. f. current and speed. The efficiency of the gearing was calculated by dividing the horse power given off on the axle by that measured on the worm shaft, and we found that the useful effect increased with the speed, viz.: at 300 revolutions of the worm it gave 80 per cent.; at 530 revolutions, 81.1 per cent. at 676 revolutions, 85.1 per cent. and finally at 770 revolutions 87 per cent. These results were then compared with the electrical energy supplied to the motor in each experiment and they were found to correspond very closely, after the usual electrical losses in the motor itself were deducted. The mechanical horse power was thus checked by the electrical horse power, and at last I applied the well-known formulæ for the efficiency of worm gear, which is given in every book on mechanical engineering.

$$\xi = \frac{\cot \theta}{\cot (\theta - \Phi)} = \frac{1 - \mu \frac{p}{2 \pi r}}{1 + \mu \frac{2 \pi r}{p}}$$

Where θ is the angle of the worm thread,
μ the coefficient of friction,
r the radius of the worm, and
Φ the angle of repose between metal and metal
ξ gives the efficiency of the pair.

If the coefficient of friction is taken at .015, then the efficiency must be 87.5 per cent.

By means of the above tests and the formulæ we can find the coefficient of friction for the various speeds.

When this apparatus was attached to the car, I found that it required less current to propel it than it did previously with the chain gear, therefore I adopted worm gear ever since. Mr. Holroyd Smith tried it recently on his cars, as alreay stated, and he told the meeting of the Society of Arts, in April last, that he "found it the most effective mode of transmitting the power from the motor spindle to the axle, taking all points into consideration,"

With these remarks closes a short and incomplete chapter on gearing. There are other kinds of gearing which I have not touched upon. I cannot do better than to leave the subject in the able hands of members present, who, I hope, will supplement, criticise and amend the observations herein set forth, and thereby add to the general knowledge of one of the most important topics of the day. We are continually advancing, every hour marks a step forward in the direction of success. The grand general principles of the electrical transmission of energy are now well understood, but there are yet many other ways of adding to the sum of human knowledge, as for example in following up the details of construction, every one of which will add in some measure to the final triumph. Even by relating our mistakes and failures we serve a good purpose. "There are," said Professor Sylvanus Thompson, "half-forgotton observations, unconnected, unexplained, and often exceptional in character, every one of which has a significance of its own—residual phenomena, every one of which is, to the scientific man, of a value beyond price. He who investigates them patiently may find the clue to their meaning and reap a rich reward from them. They are the finger-posts in the high road of discovery."—*(Concluded).*

Formulæ for Self-Regulating Dynamos.

In *London Electrician* Silvanus P. Thompson makes some explanations in regard to the practical value of formulæ given in his book "Dynamo Electrical Machinery" which may help readers in this country over stumbling places. He says: "The question whether the mathematical formulæ given in my book for the conditions necessary for the self-regulation of dynamos are found to be in accord with the practice of manufacturers, is readily answered. The formulæ themselves are in general not; the practical conclusions to which they lead are. For example, the formulæ number XXVII. for compounding a dynamo for constant potential is not verified in practice. More series turns are required than that formulæ indicates, and the reason is simply this: The assumption is frankly made at the outset that the iron in the field-magnet cores is never saturated, and that its magnetism is therefore always proportional to the number of ampère turns exciting it, whereas in actual constant potential machines the series coil is required to come into use most powerfully when the iron cores are well on toward saturation; hence, more series turns are wanted than the theory indicates But, on the other hand, the practical rule which follows for ascertaining by experiment how many series turns are actually wanted to give self-regulation is constantly used by manufacturers of dynamos. Again, the formulæ for compounding machines, to make them self-regulating for constant currents, are not used, for the additional reason that they would involve an enormous cost for the immense number of turns of wire in the shunt winding. In the expressions for self-regulating motors the formulæ are, however, again good, because in the constant speed motor, running on constant potential mains, the maximum power exerted by the series coils is called forth, not when the field-magnets are most powerfully excited and well saturated, but when they are least excited and furthest from saturation. There will be something said on these points in my forthcoming new edition."

A Cable Car's Mishap.

A dispatch from Cincinnati, dated October 2d, says: "This evening a strand came loose in the cable of the Walnut hill cable road and wrapped around the grip of a car coming west on Sixth street. The car was full of passengers, and on it went like wild, overtaking another car near Sixth and Main streets full of people. This car it pushed along. Brakes were applied, and the wheels were locked dead on both cars. On they went, striking flames into the darkness, passengers screaming, and hundreds of excited persons following in the middle of the street. In this way the runaway cars wheeled from Sixth into Walnut street, and from Walnut into Fifth at Fountain square, and, crashing eastward, they struck a horse car going east near Sycamore street. The latter street is ditched deeply where Fifth crosses it, and at the crossing the horse car horses, passengers, and all were piled in the ditch. At the same time the runaway cars were thrown from the track and stopped with a terrific wrench to the cable—so violent, indeed, that every car on the track clear up to Walnut hill was derailed. Thirty or forty people were bruised and three or four hundred were badly scared."

CORRESPONDENCE.

Eastern Electrical News.

New York, Oct. 7.—The all-absorbing topic of the day is, the final consummation of the sale of the Baltimore & Ohio telegraph property to the Western Union company. The result proves what every experienced telegrapher has known to be a fact, that the telegraph business, as conducted by the late lamented, has been a continual drain on the resources of the railroad company. A large volume of business has been conducted at a loss; the public has been educated down to cheap rates, and the same routine of street gossip, positive denials of amalgamation, has ended just as was expected by all who have witnessed previous experiments of a similar character. It appears quite possible that there will now follow a vigorous revival of various government telegraph schemes. This will certainly be the case if there is any material advance in rates, which, however, is not at all probable. Experience has pointed out the most advantageous policy, which is by no means the enforcement of a high tariff, which not only restricts the general use of the wires, but encourages the formation of opposition companies. There is the usual prediction of suffering among the operators, but a very large proportion of them will doubtless be provided for, and if those who are left out will make a vigorous attempt to secure a foothold in some of the more recently developed branches of electrical industry, they will find themselves eventually in much more congenial and healthful occupations.

The Consolidated Railway Telegraph company gave an excursion to about two hundred persons, Thursday, from New York to Easton, Pa., over the Lehigh Valley railroad, which connects with the Pennsylvania at Metuchen. The party was composed chiefly of electrical men, the occasion being the exhibition of the pra tical working of the induction telegraph system on the Lehigh Valley trains between Easton and Perth Amboy junction, a distance of about sixty miles. It has been in daily operation there for several months, and its usefulness has been demonstrated on various occasions. Numerous telegrams were transmitted to various points from the moving train and replies received. The exhaustion of the supply of champagne produced an emergency, which proved the practical benefit of the system on such an occasion at least, as a telegram to Easton brought a fresh supply, which was found awaiting the arrival of the train.

The Sea Shore electric railway was finally opened for business at Asbury Park, N. J., September 30th. The usual free trial trips were offered the public on the first day, and the citizens were highly gratified with the successful completion of the road, which has been so seriously delayed that they had begun to lose faith in the practicability of an electric railway system.

The Field motor is being run between the hours of 10 a.m. and 2 p.m., on the Thirty-fourth street branch, when the weather is pleasant. It is working satisfactorily, and may be inspected by all who are interested. The railroad people have as yet made no official examination of it.

Professor George Forbes arrived from England on the Servia this week. He visits this country to exhibit his coulomb meter at the American institute electrical exhibition, and also to read a paper devoted to it, before the American Institute of Electrical Engineers, October 11th. This instrument registers the consumption of electricity with either continuous or alternate currents, and as he will give a practical demonstration of its use, the meeting will be of unusual interest.

The electrical exhibition is not yet in complete working order, as the motor companies were so busy that they have had difficulty in perfecting their arrangements. There are plenty of novelties to be seen, however, and the outlook for a successful demonstration of the variety of uses to which electricity is now applied, is very promising.

The Paterson, N. J., Electric Light company has decided to undertake the establishment of an incandescent system in that city. Provision will be made for 3,000 lamps immediately. P.

New York Notes.

NEW YORK, Oct. 8.—The annual exhibition of the American Institute was opened a week ago Wednesday with the usual ceremonies. The exhibits at that time were in a very incomplete state, and when you correspondent visited the building the last of this week there was still a large number of exhibits not arranged or even unpacked. This was particularly noticeable in the electrical department and so at present that part of the exhibition is disappointing. About one-third of the floor space is occupied by the electrical exhibits, and the display of motors will be especially interesting. At present none are in readiness for display. The Sprague, the Daft and the C. & C. motors are the principal ones that are being placed in position. The Daft people will operate an electric car on a track 300 feet long on side of the building. They have also on exhibition one of the street cars made for the Sea Shore electric railway at Asbury Park. The incandescent lights for the building are furnished by the Tucker Electric Manufacturing company, who use the Mather system. The dynamo used is a 500 lamp machine and as a dynamo in operation is still a novelty to most people it attracted much attention. The Bell Electric company furnish the arc lights. There are about one hundred lamps for which four dynamos are used driven by one of the Ball automatic engines. The Commercial Cable company exhibit the Cuttriss cable recorder in operation and near this is the space occupied by the Writing Telegraph company. As exhibited the writing telegraph works wonderfully well and if in practical service it will do all that is claimed for it, it will undoubtedly come into popular use. The managers claim that it is a practical working success in Pittsburgh and other places where introduced. The Tropical American Telephone company exhibit complete sets of telephone apparatus used for the export business and also some imported sets made for the South American trade. The Washburn & Moen Manufacturing company make a handsome display of their make of iron and copper wire. There are small exhibits of nearly all the different kinds of insulated wires in the market. There is a large number of electro-medical batteries exhibited by various makers and a few small displays of bells, annunciators and telegraph instruments.

At the meeting of the Board of Electrical Control this week the construction company submitted a plan for the use of the subways by the different companies,—the manner of making, connections and the rate of rental. The matter was referred to Park Benjamin for advice. A plan was submitted for the building of subways for the electric light companies who have contracts with the city over streets where there are no poles at present. This provoked considerable discussion, in which Mr. Gibbens objected to having any more poles put up in the city for any purpose. The subway proposed was objected to by the mayor on the ground that it would delay the work of lighting that part of the city. He also said that in regard to the placing of the wires in the proposed conduits the law declares that a comprehensive system of subways must be adopted, that the new one now proposed is but a part of the piecemeal plan of construction which has been going on. The proposed conduit is simply an ordinary pine wood box which would rot in a short space of time. He thought that the lighting companies had made their contracts with the city with the idea that until subways were built along their lines they could put up poles. Furthermore he was opposed to granting permits to dig up the streets for any temporary expedient in the way of subways. The people of New York were already disgusted with the condition of their streets and he would never vote for the plan. He thought that under the circumstances the subway should not be built and that the poles should be put up for the present. The motion, when put to a vote, was lost, the mayor and Mr. Hess voting in the negative.

At last speculation is at an end and the Baltimore and Ohio Telegraph company has passed into the hands of the Western Union. By this transaction 1,143 offices, 7,535 miles of poles and 54,972 miles of wire passes into the control of the Western Union Telegraph company. The price paid is said to be $5,000,000 in Western Union stock with an annual rental of $60,000 to be paid the Baltimore and Ohio Railroad for the use of its railroad telegraph lines and offices.

The Baltimore and Ohio sale has caused talk in Washington of extending the principle of the inter-state commerce law to telegraph companies. A considerable portion of the heavy volume of government telegraphing to and from that city has been transacted over the Baltimore and Ohio wires. Now the United and Postal lines will be the only competing lines to the Western Union, so it is said that there will be a movement in the next congress to establish some sort of government control over the telegraph service.

Count Mitkiewicz is in the city and has been interviewed regarding the report that the Chinese government has repudiated its concessions to him. He said that he had heard nothing to that effect and declared that such a thing would be impossible as the concessions were granted by legislation and stand as laws in China. S.

Detroit's Budget.

DETROIT, Oct. 10.—Last Monday evening Hiram Corliss, superintendent of the tower lamp trimmers, employed by the Brush company, discovering that something was wrong with a lamp on Woodward avenue, climbed a pole in front of Wright, Kay & Co.'s jewelry store, and used a pair of heavy pliers to fix the wire. While at work, he was seen to suddenly drop face downward on two of the wires, which sustained his weight. A passer-by climbed the pole in an endeavor to rescue Corliss but was unable to do so. Fully fifteen minutes elapsed before the injured man could be brought to the ground. He was still breathing, but before medical aid arrived life was extinct. A singular feature of the accident is that not a single bruise or mark could be found on the body to indicate the manner in which Corliss met death. Corliss was an old employe of the company and had never met with any accident before. This accident would not have occurred had he taken the precaution to use his rubber gloves which he had in his pocket at the time.

The aldermanic committee appointed to consider the practicability of putting the electric light wires underground met to day. City Counsellor McGrath, on behalf of the city, presented a long list of authorities to the effect that wherever conduits had been tried they proved successful, Chicago, Washington, Philadelphia, being among the places cited. In rebuttal, Mr. Leggett, president of the Brush company, also introduced a large amount of evidence to show that in no case where a sufficiently long trial had been made, had the underground system proved a success in arc lighting. There was one perfect solution of the problem, and that was the one suggested in Philadelphia, to run under the street a tunnel five feet by eight feet in size, absolutely waterproof, and train the wires through it. But as five miles of such a tunnel would cost $1,500,000, no such attempt would be made here. The conclusion of the seven experts appointed by the city and state of New York to investigate the working of the conduit system in that city, was that, all in all, the system was impracticable. A practical test had been made in Detroit. The Thomson-Houston company having had endless trouble with its conduit wires, placed duplicate machines side by side, and transmitted equal currents over wires of the same length, one overhead and one underground, to lamps of the same kind. Under these equal conditions, the aerial line worked perfectly; the one in the conduit, very badly. No conduit system yet applied had passed beyond the experimental stage. If any was brought forward, the practicability of which was demonstrable the Brush company would willingly comply with the law, as it is ready and willing. Such a demonstration, however, takes time, and the conduit and cable which worked reasonably well when put down, might fail the next year. The system in Chicago worked indifferently for a year, then sagging, condensation, accumulated gas and leakage rendered it useless, and every mile was taken up and replaced with a different one. Burn-outs averaged one a day, and groundings were too frequent to keep track of. Mr. Leggett in conclusion, urged that in view of all the evidence adduced, the question should be regarded as settled until the application of the conduit system had passed beyond the experimental stage. After replies by the mayor and city counselor, which were mainly of *pro bono publico* kind, the committee rose.

Mayor Chamberlain has again vetoed the electric light contract. The whole difficulty seems to hinge on the underground question. At the the last meeting of the council he returned the resolution directing the controller to enter into a contract with the Brush company without his approval. He did this because the proposition of the company, and the contract based upon it involved the consent of the city to the breach of one of its own ordinances — that of requiring wires to be placed underground.

Judge Marston, counsel for the company, was asked what would be done next. He replied: "We will do nothing, the matter rests with the council. If our wires are ordered underground, down they go, but we will not be bound by any three-years contract to furnish light under the terms proposed. We will not sign the contract prepared by the controller agreeing to put the wires underground." All that can be done is to re-advertise. C.

Omaha Gossip.

OMAHA, Oct. 7.—The Omaha Illuminating company are wiring several private residences in this city for the United States system of incandescent lighting. The owners have no intention of putting in their own power, but expect to see the central station power extended at some future day, or use storage batteries. It goes to show what confidence the public place in the electric light for residences.

The Thomson-Houston company will start the incandescent part of their plant in about ten days with 200 lights and have orders for about as many more.

The Electric Light & Power company of Council Bluffs will begin at once the erection of towers for lighting the city similar to those used in Detroit. Nearly all material needed is on the ground, and the work will be pushed rapidly. The city will be lighted entirely by electric light and gasoline lamps, the present gas company, whose high rates have brought about this state of affairs, being ignored. A franchise to manufacture gas was recently granted a new company of Chicago parties, and if consolidation is avoided, a lively competition will ensue. The outcome will be watched with a great deal of interest.

The Nebraska Telephone company, operating the Council Bluffs exchange, has applied for an injunction restraining the Electric Light Power company of Council Bluffs from erecting its poles and wires on Broadway, between and among the telephone wires. It was intended to string electric light wires on a portion of this street, eight feet above the telephone wires, and on another portion to string them parallel. From such a condition of things the telephone company is protected in Omaha and other cities by city ordinances, and it is seeking the same protection in this instance.

The Lincoln exchange of the Nebraska Telephone company has been moved to more commodious quarters to accommodate their rapidly increasing list of subscribers, who now number over 400. A spring-jack and cord switch-board of their own manufacture has been put in. It has a capacity of 1,000 subscribers, and the old net-work of wires leading from the central office has been replaced with 4,000 feet of 100-wire Patterson cable. The entire exchange has been rebuilt with new lines strung on tall poles on all prominent streets and present a handsome and decidedly improved appearance. In a number of cases property owners who objected to "the erection of unsightly poles" near their premises, interfered with the progress of the work, by the injunction plan—notably in one instance where the lady of the house, and one prominently known, planted herself in a partially dug hole, and stood there some two hours or more defying the workmen, until a messenger was dispatched for and received an injunction. All injunctions were dissolved, however, and amicably settled by compromise, reasonable concessions being made by both property holders and the company—the citizens appreciating the

efforts and rendering the company assistance to improve the service.

The agents of the Cushman telephone have offered to build an exchange at Fairbury, Neb., and furnish instruments at a rental of $30 per year, but the citizens, learning of the probable interference by the American Bell Telephone company, for infringement, have so far refrained from accepting the proposition.

The Midland Electric company, Omaha, have moved into a larger and more convenient building, with a view of increasing their already prosperous business. They will be pleased to see their friends at their new store, 1,213 Harney st.

W. W. Smith, general manager of the Missouri & Kansas Telephone company, was visiting his Omaha friends this week.

L. H. Korty, superintendent of the Union Pacific Telegraph company, is visiting in St. Louis this week. W.

From the Pacific Slope.

San Francisco, October 1.—The Union Iron Works, of San Francisco, are building another steamer for the Canadian Pacific line. It will be lighted by Edison lamps.

St. Helena, Cal., wants the electric light.

The death of Captain William Short Symes, of the West Indian & Panama Telegraph company steamer, at St. Thomas, is recorded.

Four different companies holding as many different franchises for running electric street railways in Stockton, Cal., have had a meeting to settle upon many points, such as crossings, on which they might hereafter conflict.

Berkley, Cal., has ordered an electric light plant similar to that in Alameda, including towers and cranes. The Jenney company's system will be used.

The promoters of the trans-city street railroad at Oakland, Cal., propose to use the electric motor for propelling the cars. The city engineer is now at work on the plans for a bridge across Lake Merritt. The proposed bridge will be 1,200 feet long and will be built upon piers.

The Southern Pacific and Central Pacific railroad companies have contracted with the Alameda City Electric Light company to light eighteen stations on their roads. The Indianapolis Jenney system will be used.

In Cochin China some long spans of telegraph wires are to be found, which far exceed any in this country. Over the river Mekong there is a span of 2,560 feet, strung from poles at each side 160 feet high. The wires are silicon-bronze, one .04 inch and the other .055 inch diameter. Over a tributary to the river another similar construction is to be found. There is one span of 1,670 feet, and it is 114 feet above flood water. S.

Indianapolis Items.

Indianapolis, October 8.—Articles of association of the Todd Transcontinental Telephone company have been filed with the secretary of state. The company's place of business is to be located in this city, where they propose to manufacture a telephone invented by Hubert L. Todd, of Washington, D.C. The capital stock is placed at $10,000,000. The directors are H. L. Todd, Ashton Todd, of Newberg; Frank M. Trissall, Noblesville, Ind.; Thomas B. Ward, Lafayette; Charles W. Adams, Chicago; and E. J. Ellis, Washington.

The suit filed by the attorney-general some time ago, against the Central Union Telephone company for back taxes and penalty, was dismissed last week. A compromise was effected, the telephone company making the required report and paying taxes for the past four years, amounting to $1,641.

The sheriff from Logansport, Ind., arrested Manager Dunseath, of the Lafayette telephone exchange, and took him to Logansport, where he was charged with exacting of subscribers more than the legal rate for telephones. He gave bonds and was allowed to return to Lafayette. If this charge can be made to hold when trial is had it will be rather a dangerous precedent.

Manager D. T. Bacon, of the Baltimore and Ohio Telegraph company at this place, has resigned and will re-enter railroad service. Chief-operator Lehman has been promoted to the managership. M.

Cincinnati Chat.

Cincinnati, Oct. 10.—The accident of last week on the Walnut Hill cable road has brought out the need of electric signals, to be used in case of any trouble, so that the cable can be stopped and the piling of four or five cars up together can be avoided. The first plan suggested was to place a number of boxes, similar to those used in the district messenger service, at intervals along the road, and divide the line into stations. This would compel them to keep a boy on each car and would be a continual expense, but the talent of Cincinnati electrical inventors came to the rescue of President Kerper, and he was besieged by electricians with their various plans, some of them very complicated. The simplest will probably be chosen. It consists of one wire running through the tunnel, connections being made from the grip, and in case of any accident each gripman has the power to signal the ingineer at the driving station, and the whole line will be at once under his control. It will undoubtedly save an enormous expense in way of repairing cars.

The Betts street Furniture company, of this city, have, by good work, pushed their business until their special line of goods are sold in all the large cities of the United States. They have just closed a contract with The Queen City Electric company for an electrtc light plant for their factory. This contract was made after a careful investigation of the merits of all the different dynamos in the city. M.

Personal Paragraphs.

The interests of the Brush company in the south are being looked after by Secretary W. F. Swift, who has located for the time in Atlanta, Ga.

W. B. Roberts, general manager of the Gogebic Telephone & Electric company of Hurley, Wis. was in town last week visiting friends.

H. A. Glasier, of the Jarvis Engineering company, of Chicago had the misfortune to have the little finger of his right hand crushed in the door of a carriage a fortnight ago. Inflammation set in and for some days it was feared that mortification would ensue. Serious consequences were averted, however, and now he is attending to business again.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	385	400
Central Union	44	45
Michigan	72	73
Great Southern	28	30
Colorado	18	20
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27
Missouri & Kansas	69	70

NEW ENTERPRISES.

C. E. Cooper, of Kansas City, Mo., will erect a three-story residence to cost $7,000. It will be provided with electric bells.

The Kansas City club is making preparations to put up an elegant club house. The estimated cost is $110,000. It will be three stories in height, provided with electric appliances, heated by steam and in all respects be a model club house. Dr. Sinclair Street, Brunswick hotel, Kansas City, Mo., is in charge of the building arrangements.

L. Bacon, of 1010 Holmes street, Kansas City, Mo., will erect a handsome three-story residence to cost $15,000. It will be equipped with the latest electrical appliances.

The Peru Electric Light company, of Peru, Ill., is in the market for the fittings for an electric light plant consisting of a fifty arc light dynamo and a thirty-light combined arc and incandescent dynamo.

At Auburn, Ala., work will be begun at once on the main building of the Agricultural and Mechanical college. Bruce & Morgan, of Atlanta, Ga., are the architects. W. L. Brown, of Auburn, Ala., is in charge of the building arrangements.

W. N. Phillips, of Galesburg, Ill., is about to build a block of three stores, two stories in height. The stores will be lighted by the electric light.

At the same place A. M. Craig will put up a building to be used as a store. The electric light will also be put in.

THE ELECTRIC MOTOR.

The three weeks' test of the Field electric motor on the Thirty-fourth street branch of the Third avenue elevated railroad, in New York, ended on the 7th inst. The trial was successful.

Eleven miles of track for an electric street railroad have been laid in Richmond, Va. The steep grades and sharp curves make the construction a complicated one.

October 8th the St. Catherines street railway opened their six miles of road between that city and Thorold to the public. It is run by electricity, on the Van Depoele system, and proved a perfect success in every particular; far exceeding the expectations of the managers. The electricity, which is generated by water power at lock 12, Welland canal by a 1,160 horse-power dynamo, is conducted by overhead copper wires connecting with the cars by means of small wheels which run along on the wires and thence through a flexible conductor to the motor. The company expect to have twelve motor cars on within two weeks. The time of traveling between St. Catherines and Thorold has been reduced to twenty minutes. The cars are under perfect control, being stopped and started without any jerking motion, going around curves of forty degrees and up grade of 7 per cent. without the least difficulty.

THE ELECTRIC LIGHT.

The city of Lewiston, Me., is to be lighted by electricity to the exclusion of gas. One hundred arc lights of two thousand candle power each are to be placed on the streets immediately. It is thought this number will be doubled within the coming year.

The city council of Parsons, Kansas, has contracted to take ten arc lights of the local electric light company and pay $96 each per annum.

Liberty, Mo., is now rejoicing in the electric light.

The electric light has been placed in the works of the Judson Iron works, of Oakland, Cal. The works are running night and day.

The Parsons, Kansas, electric light plant is now in operation. Originally the plant was designed to furnish 35 lights, but before the system was started, 33 of the lights had been subscribed for. Steps have been taken to enlarge the plant.

F. A. Cloudman, of Kingston, N. Y., inventor of the present system of ocean light-ship stations, has received an invitation from the British government to try his hand at electric light buoys, to be maintained at certain dangerous points on the English coast.

The Peru Electric Light & Water Supply Co., Peru, Ill., is a recently incorporated company; capital stock $8,000; incorporators: W. K. Hoagland, Theodore Wiberling and William E. Moore.

Council Grove, Kansas, is to be lighted by a plant of the Thomson-Houston system. The city pays for five lights at the rate of $100 per annum for each light of 1,200 candle power. The power for the plant will be furnished by the water works company, and it is expected that the system will be in operation by November 1st.

The Merchants' hotel, of South Hutchinson, Kansas, is to be lighted by electricity.

John W. Phillips, vice-president of the Kansas City Electric Light company, while suffering temporary aberration of the mind, committed suicide by shooting himself in the head, September 30th. Suitable action was taken by the board of directors, who spread upon their minutes a memorial recognizing in the death of their late associate "the loss of an esteemed friend and valuable officer, one who possessed the entire confidence and highest regard of the board, and whose good judgment, ability and sterling integrity will make his place difficult to fill."

Minneapolis, Kan., is to have the electric light.

A. P. Johnson, of Carthage, Mo., has purchased a half interest in the electric light plant at Girard, Kan.

With the proposed addition to the electric light plant at McPherson, Kan., the capacity will be 65 arc lights and 400 incandescent lights.

"How cheap are you going to furnish us electric light during the coming year?" asked Chairman Simpson, of the Cleveland city council lighting committee, of Mr. Cook, of the Brush company, at a recent meeting. "Cheaper than it is furnished in any other city in the country except Rochester, N. Y.," said Mr. Cook. "It is furnished cheaply there because water power is used. With that exception, electricity is furnished in Cleveland cheaper than anywhere else in the world."

The board of public affairs met as a committee of the whole yesterday afternoon, says the Cincinnati *Enquirer* of the 4th, to consider the ordinances drawn up by the Edison Electric Light company, and brought before the board for its approval, granting the privilege to the company to put in a plant and the exclusive use of the streets to lay conduits for furnishing light and power. The matter has been before the board for many months, and was at last decided yesterday afternoon. General Hickenlooper was present to look after the interest of the gas company, and offered suggestions and plans touching upon the operation of an electric light plant. Communications as to the cost and manner of conducting plants were read from several companies, and much discussion was indulged in relative to the merits of electricity and gas. It was finally decided, as the sense of the committee, that no exclusive grant should be made to any one company to lay conduits or erect posts for their especial use in furnishing electricity for power or lighting, but that a uniform system should be adopted whereby all companies that may make application in good faith for such privilege may enjoy the same advantage and share alike in the distribution by a common system of conduits, to be confined to the alleys of the city, except where necessary to cross streets for connection. This action of the board knocks out two other ordinances and applications for exclusive conduit rights—one from the Haas Electric Lighting company, and another from H. H. Hoffman and others.

THE TELEPHONE.

There is a telephone strike in progress in Memphis, Tenn., occasioned by an increase in rates on the part of the company. It is said that over a thousand subscribers in that city have ordered their telephones taken out.

The Nebraska Telephone company has completed direct telephone connections between Nebraska City and Omaha by way of Plattsmouth. In the spring the company will extend this line to Auburn and the southern part of the state. A line will also be put across the river and join the Iowa company's line at East Nebraska City, giving direct telephone connection with every important town in Iowa.

The Combination Telephone company, of Girard and Pittsburg, Kan., is a recently incorporated company; capital stock $500; George W. Crawford, president.

The Cushman telephone is to be put in use at South Bend, Ind. In Michigan, lines are being built from Lansing to Charlotte and from Lansing to Corunna. Superior, Wis., is also to have a Cushman exchange.

The telephone exchange in Wichita, Kan., was to be removed to another building a block and a half away and up to the fourth floor. The exchange numbers 350 subscribers and their wires terminate in seven sections of switch-board. Elaborate preparations were under way to cause as little delay as possible to the subscribers, but a recent Saturday evening, when there was but little business on the lines, Evan Gerrard, the manager, and J. H. Flinn, the electrician, seized the opportunity and moved the entire apparatus of the exchange in just forty-two minutes. The record is a good one, and it is doubtful whether the time could be bettered.

A. J. Wittman pleaded guilty to forgery before Judge Altgeld in Chicago, on the 6th, and was sentenced to Joliet penitentiary for four years. He was formerly confidential bookkeeper for the Chicago Telephone company, and forged checks to the amount of $18,000. Of this amount $3,000 was recovered, making the net amount of his stealings $15,000.

The German administration of telegraphs, finding that the telephonic line between Berlin and Hamburg suffers from too much traffic, has reduced the duration of each conversation from five to three minutes, the price remaining the same.

A successful experiment was made at Bellevue hospital, October 5th, with a telephone probe for the location of a bullet. A man named Schroeder, who had received a bullet in his body a couple of nights previously while attempting a burglary, was the subject. A small steel plate was placed on the man's leg. To one end of this was attached an insulated wire connected with a telephone receiver, which in turn was connected with another wire, at the end of which was a probing-needle. This needle was inserted in the wound, and an electric current established. The needle was pushed in through the wound until a slight clicking sound, heard by the operating surgeon, who held the receiver at his ear, notified him that the current had been broken by the needle touching the bullet sought for. Further probing showed that the bullet had been correctly located in Schroeder's liver. The probe used is an improvement on that of Professor Bell, with which it was sought to locate the bullet in President Garfield's body, but which failed because, as Professor Bell explained, it was too crudely constructed.

THE TELEGRAPH.

A successful exhibition of telegraphing to and from a train on the Lehigh Valley road was given October 6th. With the train going a mile a minute messages were sent, news and stock quotations were handled perfectly, and the conductor was instructed as to the running of his train.

Bertie Kintner, a bright messenger attached to the Western Union office at Stroudsburg, Penn., is only ten years old, yet he is a fair operator. George Jackson, of Rochester, N.Y., is but twelve years of age, though from his stature he would not be credited with having seen over nine years. He is employed by the United Lines, and very satisfactorily handles all business that passes through his hands.

The cable steamer Britannia is at Tor Bay, N. S., making ready to remove the two direct cables from that point to Halifax, N. S. Halifax is some ninety miles nearer New York. The change will be a welcome one to the cable people, as the stations are usually established at some out of the way place. It is thought this change will be the forerunner of others, and hereafter new cables will be landed in cities instead of desert spots. The Britannia has on board new cable for the extension to Halifax. The change also involves quite a saving to the company.

The Federal Telephone company, of Montreal, advertises a capital of $250,000, and that it is about to establish a telephone exchange in that city at the rates of $35 per annum for business places, and $25 per annum for residences, guaranteeing a reduction of fifty per cent. in the present telephone rates.

In the libel of the Sunset Telephone and Telegraph company against the ships Carl Frederick and Enoch Talbot, Judge Hoffman has rendered an interlocutory decree in the United States district court at San Francisco, awarding judgment for the libellant against the claimants of the Enoch Talbot and dismissing the libel as to the Carl Frederick. On the 8th of August, 1885, these vessels, while riding at anchor in the bay, collided, fouling their rigging, and while thus entangled dragged their anchors across the company's cable, damaging it considerably. The ascertainment of the damage caused by the Enoch Talbot has been referred to United States Commissioner Hoffman.

The other day some one threw a wire bustle over the wires of a telegraph line near Altoona, and, as a local paper expresses it, "disconcerted the wires so much that they refused to work." A lineman had to be sent to remove the bustle before the wires could be used. This useful adjunct to the feminine toilet certainly has a good deal to bear. In the first place, it gets crushed and battered out of shape in the street car, and then it has to withstand the jibes of alleged wits, and now, last of all, it stops the business of a telegraph company, and consequently has to bear all the hard words that are uttered under such circumstances. Unquestionably, reformers in the dress of women will use this incident as another and most conclusive argument as to why the bustle should go.

Miscellaneous Notes.

A French manufacturer has applied electricity to the aid of weavers in a somewhat curious manner. He has attached to each of his looms an indicator which sounds when a thread breaks, rendering unnecessary the eye-wearying watching of the fast-moving threads.

The national fire record for September shows an aggregate loss of $7,937,900, against $6,500,000 in September, 1886. The total for the first nine months of the current year is $93,183,500, against $83,400,000 for the corresponding period of 1886.

While Doyle Brown, of Talking Rock, Ga., was shoveling up chips, lightning struck the handle of the shovel and split it in two. The charge then divided and ran through both of Brown's hands and arms and passed out at the back of his neck, killing him. An old man twenty feet away was knocked senseless.

The Niagara Light & Fuel company, of Chicago, is a recently incorporated company; capital stock, $1,000,000; incorporators, Edgar L. Hance, Alfred E. Barr, and Samuel Kerr.

Mr. and Mrs. J. B. Collins of Jamestown, N. Y., were reading in their sitting room the other evening, when, after several preliminary sniffs, Mr. Collins said that something was burning, and at the same time saw smoke arising from the carpet. Investigation showed that the colored glass globe had been melted by the burning gas and was dripping down upon the carpet, causing the smoke.

Business Mention.

Marshall Field & Co., of Chicago, have ordered 50 additional lights for their mammoth dry goods house, increasing their plant from a capacity of 180 to 230 full arc lights of the Western Electric system. This is the best lighted dry goods warehouse in the city of Chicago.

The Golden Illuminating Co. of Golden, Colorado, has been incorporated, with a capital stock of $20,000. A 400-light Edison incandescent plant will be put in, also a 100-light long distance incandescent system. The dynamos will be driven by Ide engines.

A new use has been found for okonite tape. Mr. Wetmore, agent for the company of that name, found it was largely used by the girls in a telephone exchange in Michigan for chewing gum. They liked it particularly because "it never wore out." Okonite receives many words of praise for its other good qualities, but this seems to be the first time that its durability and elasticity have been subjected to so severe a test as that of the well developed jaws of a telephone exchange girl.

The Western Engineering company of Lincoln, Neb., are out with an announcement of their organization and purposes in an exceedingly neat and tasteful little pamphlet in the highest style of the "art preservative. They are prepared to install complete plants, including steam and electrical machinery for arc and incandescent lighting, central station or isolated; and for the transmission and distribution of power, including the equipment of street railways. They will also install electric motors and equip houses and hotels with electrical appliances. J. G. White is general manager of the company.

The Western Electric company of Chicago will fit up the Grand Avenue hotel — a 300-room house — at Kansas City, Mo., with hotel calls and return calls and will wire the building for incandescent lights.

The Woodbury Engine company, Rochester, N. Y., have issued a neat card illustrating their automatic cut-off engine of medium speed. This engine is made in four sizes: 10"×15", 12"×18", 14"×21", and 16"×24". R. W. McCready, of Chicago, has one of the 12"×18" size. No better engine is made.

The Archer Electric Manufacturing company, of Wichita, Kan., has secured the contract for the electric light plant at Lyons, Kan. The plant will consist of 30 arc lights and 400 incandescent lights. The Fort Wayne Jenney system will be used.

G. S. Maxwell, electrician of the Ohio Valley Telephone company, writes from Louisville, Ky., to the Western Electric company, of Chicago: "Your make of cable leads them all. I put in the last 20-wire cable you sent us, and there are working through it one line 42 miles long, one 60 miles, and thirteen from six to eight miles long, all of them running side by side for six miles, and yet there is absolutely no perceptible induction on the extra wires in the cable, and no appreciable increase over that on the lines when worked over the same distance on the poles."

H. A. Glasier, western manager of the Jarvis Engineering company, 81 Lake street, Chicago, returned recently from a northwestern trip, including St. Paul, Minneapolis, Appleton, Wis., Duluth, and Tower in the Iron Mountain range, and brought back orders aggregating about $6,000 for furnaces. The company is now setting three boilers in the Nicollet house, Minneapolis; building a chimney on the Jarvis plan and setting four boilers for the Kalamazoo Paper company at Kalamazoo, Mich., which makes the third order for furnaces received from that company; setting four boilers at Austin, Tex, for the water works company; two boilers at Harper, Kan., for the water works company; four boilers for one concern, and another boiler for another concern in Cleveland.

During the month of September the Thomson-Houston Electric company, Chicago, sold 493 arc lights and 2,550 incandescent lights. These figures give a good idea of the extent of the business of the Chicago office of the company.

An interesting and instructive exhibit at our state fair is that of the Midland Electric company of Omaha, says the Nebraska *State Journal* of the 16th ult., which is quartered in the northeast corner of the east wing of art hall. This company is thoroughly established and has such men of recognized financial ability and business tact to conduct its management as J. J. Dickey, president; Israel Dovett, superintendent; H. J. Wells, secretary and general manager; L. H. Korty, treasurer, while the exhibit is under the supervision of H. A. Kinney, an electrician of years of experience in successfully displaying the wonders of this invisible force. The principal business of the Midland Electric company is putting up hotel annunciators. Among the hotels they have recently furnished is the Barker house in Omaha, which contains 150 numbers; the new large hotels at Norfolk and Wymore each this state, and they are placing them in many of the Pullman palace cars, connecting each berth with the porter's room. Their system of automatic gas lighting by electricity is very complete. By touching a button the gas is ignited in any part of the house and extinguished by the same means. Ex Mayor C. C. Burr and others of this city are using this system in their residences. The multiple gas lighting process as operated by this company is of the latest and most approved method, by which any number of burners can be lighted at once. An extensive and complete system has recently been put in the new Grand opera house in Omaha, in which about 200 burners are lighted instantly. In their burglar alarm system the annunciator is placed in the sleeping room, with concealed wires connecting it with the doors and windows so perfectly that if any of them is disturbed it will give the alarm and indicate in what portion of the building it occurs. This enterprising company has a system termed "the watchman detector," with which it has furnished the Woodman Linseed Oil company of Omaha. The clock or register is placed in the office and connects with boxes or stations in the different departments of the mill, which the watchman is required to touch on going his rounds, and which registers in the office his visits to the various rooms, being a check on his faithfulness.

Foreé Bain of 95-97 Indiana street, Chicago, has taken orders within two weeks for eight electric light plants; six of these are for use in Chicago and two outside of the city. Seven of the dynamos are for arc lighting, ranging from five to ten lights each and the eighth is a thirty light incandescent dynamo.

The electric light system at Mt. Vernon, Ill, was put in operation the 14th ult. for the first time. The plant is owned by the Mt. Vernon Electric Light company, an incorporated stock concern, of which Allan C. Tanner is the president. It consists of an Excelsior twenty-five arc light dynamo and fixtures. The lamps are suspended from forty foot poles set at the intersection of the principal streets. The power is furnished by a forty-five horse-power automatic Westinghouse engine. The company desired to get the plant in operation the night of September 14th inasmuch as a soldier's reunion was to be held there Extraordinary efforts were put forth by C. L. Coombs erecting engineer and agent of Fairbanks & Co. of St. Louis and C. J. Reilly electrician of the Excelsior company and their efforts were crowned with success. Notwithstanding the rapidity with which the work was done there was not the slightest flicker in the lamps. After the trial a number of contracts were made with business men for incandescent lights and a second dynamo will be put in operation at once.

The United States Electric Lighting company, through C. C. Warren manager of the Western department, 216 La Salle street, Chicago, Ill, sold 2,850 lights the second week of September.

The Edison Electric Light company of New York has issued the following circular letter to its local companies; "For some time past we have been negotiating with the Electrical Accumulator company with a view to securing for our licensees and isolated customers upon suitable terms the advantages of a good storage battery. There is no doubt that such will under many conditions prove an important economic acquisition to an electric plant. We have adopted the battery of the Electrical Accumulator company for recommendation to our licensees only after it has been subjected to exhaustive trial and proven to be of practical and commercial utility in electric lighting. Our company has no interest whatever in the Accumulator company and does not derive any benefit or profit directly or indirectly from the sale of these batteries. We are prompted to make this arrangement solely in the interest of our licensees and isolated customers whom we desire to become possessed of any and all improvements that may from time to time be demonstrated to possess practical utility. While it is entirely optional with your company to enter into a similar agreement for the introduction of these batteries in your territory we desire to impress upon you the practical importance of so doing, and to say that as shareholders in your company we desire it. Our experience and oversight, covering a wider range than your own, justifies us in claiming your careful consideration of our judgment in this and kindred matters, and we hope to be apprised promptly by you of your willingness to accept the agreement as it stands, believing as we do that your best interests are therein carefully guarded and conserved."

Electrical Patents.

Issued, Tuesday, October 4th, 1887.

370,794. Dynamo-Electric Machine. Wilhelm Lahmeyer, Aachen, Prussia, Germany.

370,801. Electric Gas-Lighter. John J. McGowen, Ithaca, N. Y.

370,831. Electric Signaling Apparatus. Jacob P. Tirrell, Boston, Mass.

370,847. Resonant Attachment for Telephones. Edward A. Balloch, Washington, D. C.

370,851. Fire-damp Annunciator. August Berghausen, Elberfeld, Germany.

370,885. Fire-alarm and Police Telegraph System. Alexander M. Neeper, Pittsburgh, Pa.

370,894. Electric Car-brake. William M. Schlesinger, Philadelphia, Pa.

370,898. Telegraph-Receiver. Charles Selden, Baltimore, Md. A system of duplex telegraphy in which two independent receivers are actuated, one by a succession of long waves and the other by a succession of short waves.

370,932. Electric Alarm-clock. Edward J. Colby, Chicago, Ill.

370,955. Subterranean Electric Line System. George W. LeVin, Chicago, Ill. The invention relates to a system of underground wiring and distribution of wires. Economy of space in manholes and convenient handling of cables are the leading advantages claimed. A pulley to aid in drawing in the cables is anchored at the bottom of the manholes when desired.

370,978. Printing-telegraph. Robert J. Sheehy, New York, N. Y.

The type wheels are driven by a motor instead of springs. Two line wires are used.

370,992. (1) Process of Treating Electric-light Filaments. 370,993. (2) Incandescent Electric Lamp. 370,994. (3) Process of Evacuating Globes for Incandescent Electric Lamps. 370,995. (4) Process of Manufacturing Filaments for Incandescent Electric Lamps. 370,996. (5) Process of Evacuating Globes for Incandescent Electric Lamps. 370,997. (6) Method of Evacuating Incandescent Electric Lamps. 370,998. (7) Process of Forming Filaments for Incandescent Electric Lamps. 370,999. (8) Manufacture of Incandescent Electric Lamps. 371,000. (9) Process of Bending Filaments for Incandescent Electric Lamps. 371,001. (10) Process of Treating Filaments for Incandescent Electric Lamps. 371,002. (11) Process of Treating Filaments for Incandescent Electric Lamps. 371,003. (12) Incandescent Electric Lamp. Edward P. Thompson, Elizabeth, N. J.

(1.) The carbon filaments are given a permanent set by heating them by an electric current until they break.

(2.) A current of great quantity but low electromotive force, is sent across a bridge piece, connecting the leading-in wires, while the globe is being exhausted. The current is gradually increased until the bridge is fused at a central nick or point of high resistance. The leading-in wires are thus deprived of accluded oxygen.

(3.) After the globes are exhausted as far as possible, in the usual way, they are charged with an attenuated compound of gases, which will combine with each other under certain conditions. This mixture is then pumped out as far as possible, when the remnant of the compound is caused to combine chemically. This compound is then absorbed by some suitable chemical substance.

(4.) The filament is placed straight and under tension in an atmosphere of hydro-carbon, and heated by current until it is carbonized, when it is caused to break at a predetermined point by over-heating at that particular point. The filament is then bent and heated, after which it is mounted in the lamp, being provided, however, with three leading-in wires, instead of two as heretofore. At one terminal is formed a point of high resistance, at which point the filament is broken after the evacuation has been effected.

(5.) Series of chambers are provided in which explosions may be caused, one at a time, during the operation of the vacuum pump. The explosion chambers are cut off from the main exhaust-tube by wire gauze partitions. Mercury in the vacuum pump prevents the globes from exploding, which itself receives and yields to the concussion.

The mercury having yielded additional mercury flows behind the atmosphere which is displaced, and this is carried off by the pump.

(6.) Disruptive discharges of electricity are caused within the evacuating chamber during the operation of the pump. The atmosphere being thus displaced, more is carried off by the pump than would otherwise be possible.

(7.) Carbon is deposited on the original filaments by heating the original filament when surrounded by hydro-carbon vapor. Sulphur vapor is then substituted for the hydro-carbon vapor, and the sulphur attacks the original filament. The process is repeated until substantially all the original filament is removed, the resultant filament being essentially the deposited carbon.

(8.) The filament after being formed is bound together, for insertion in the globe, after which the ligature is fused, thus permitting the filament to expand.

(9.) One end of the filament to be bent, is supported in a fixed clamp, the other end in a clamp moving in the arc of a circle. The movable clamp carries one end of the filament towards the fixed clamp, while the filament is incandescent. Gas of hydro-carbon may be furnished to the filament while being flexed. By sending increased current through the carbon at any point of its flexure, it may be broken to produce a permanent set of the molecules.

(10.) The invention consists in removing the loose particles by causing a static electrical discharge to take place from the filament before it is inserted in the lamp and treating the filament with hydro-carbon.

(11.) The carbon filaments are dipped in hydro-carbon liquid to remove the oxygen from the filaments; the filaments are then dried and surrounded by an atmosphere of hydrogen.

(12.) A small section of the filament is constructed so that it may be included in a separate circuit, or in different secondary circuits derived from converters independently of the remaining portion of the filament at will. When only a small illumination is desired, this small section only may be employed.

371,111. Conduit for Electrical Distribution. Thomas Wallace, New York, N. Y.

371,121. Thermostat. William H. H. Barton, Brockton, Mass. The thermostat indicates the temperature on a scale, and may be set to give warning at a distance.

371,147. Railway signal. Peter Milroy. Jerauld County, Dakota.

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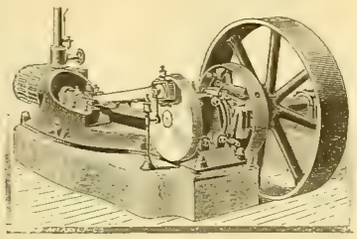

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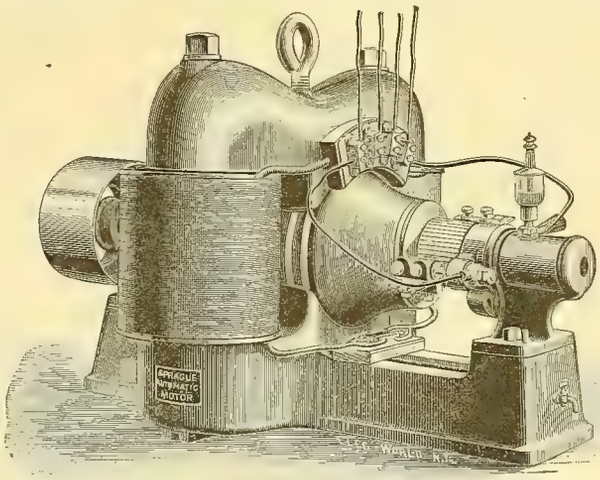

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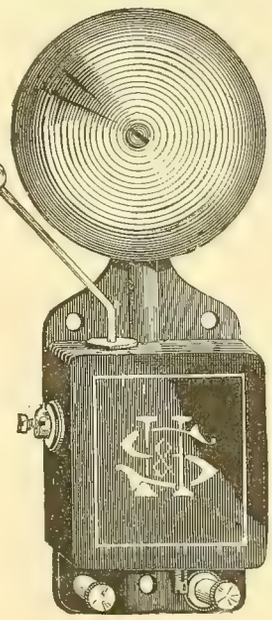
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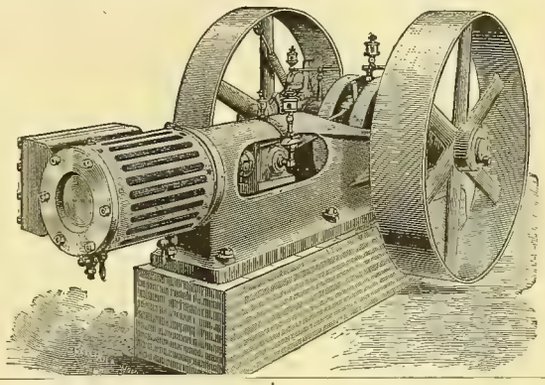

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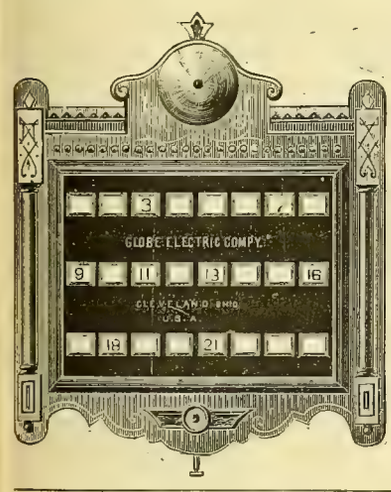

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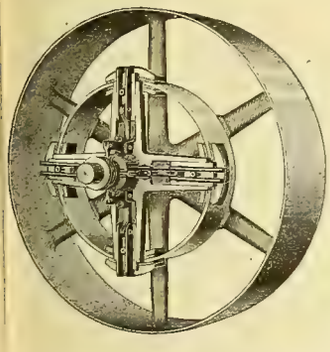

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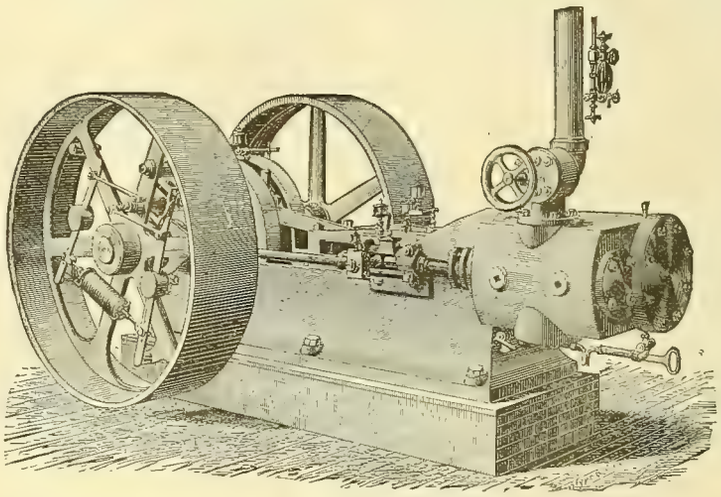

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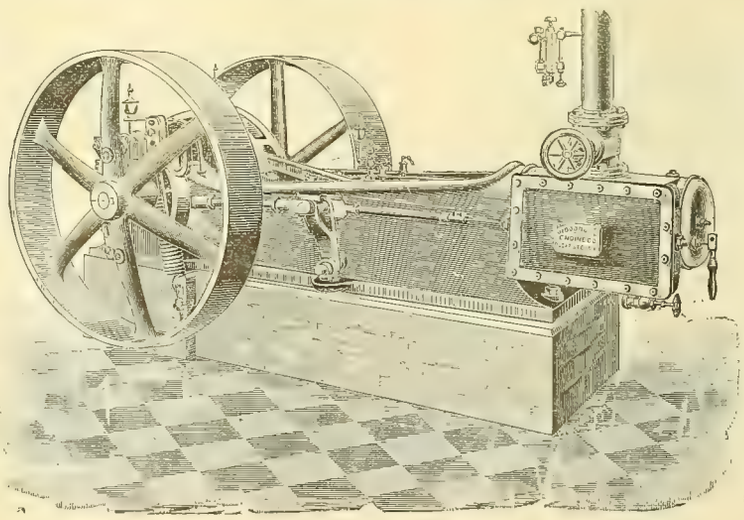

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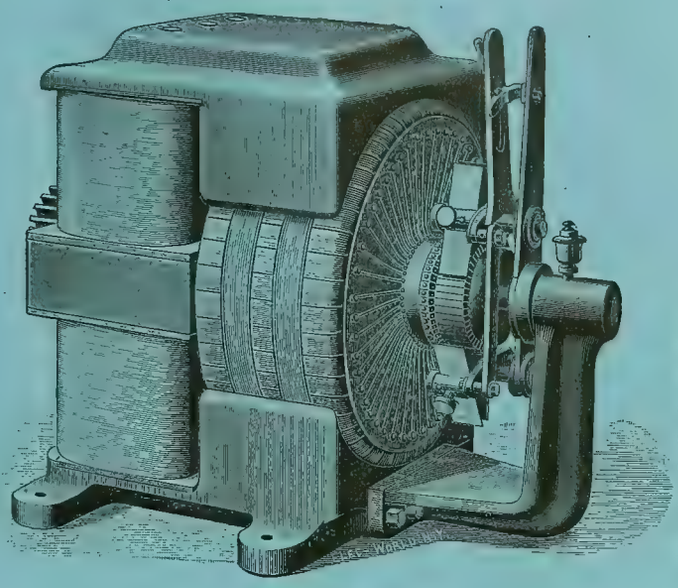

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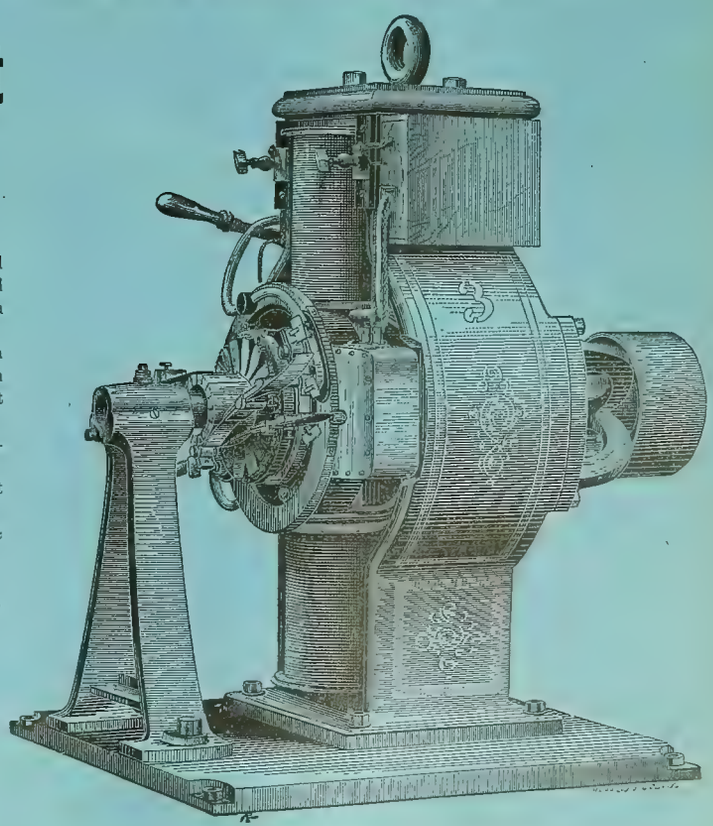

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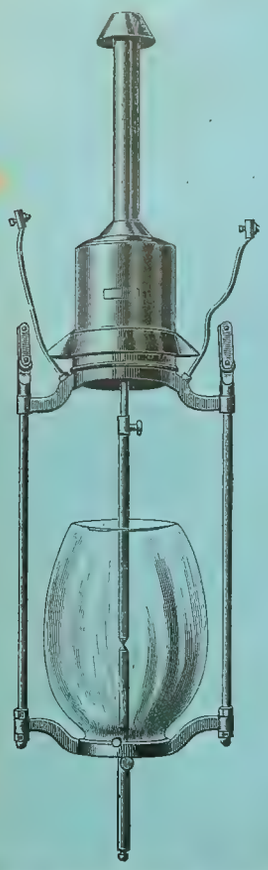

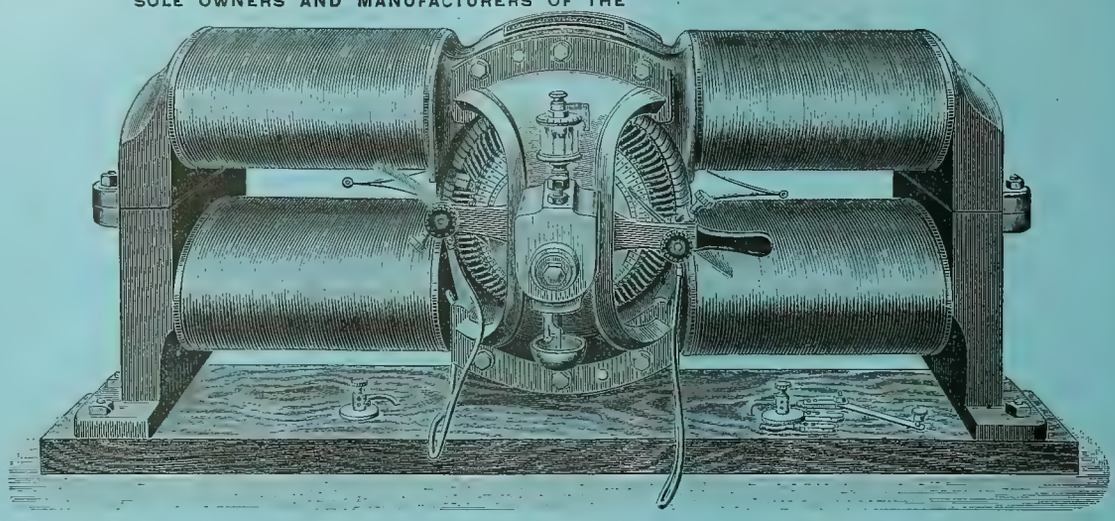

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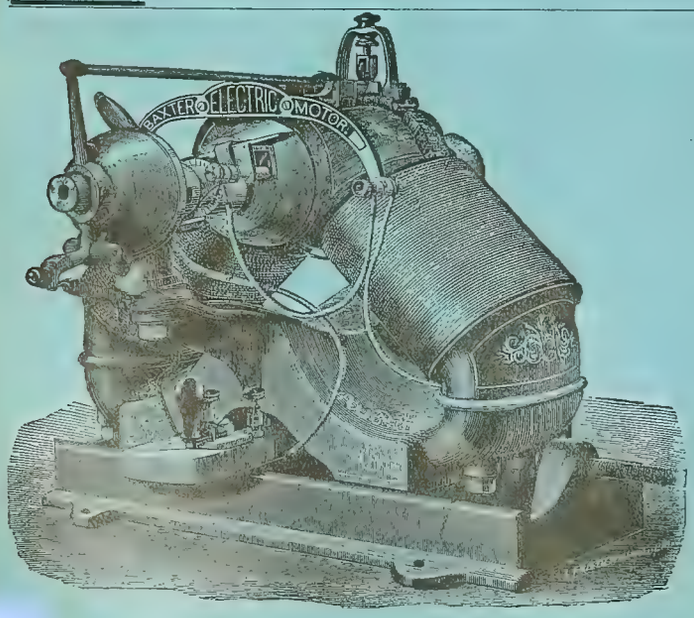

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Vol. I. CHICAGO, OCTOBER 22, 1887. No. 17.

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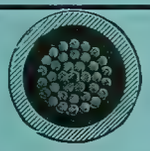

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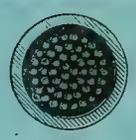

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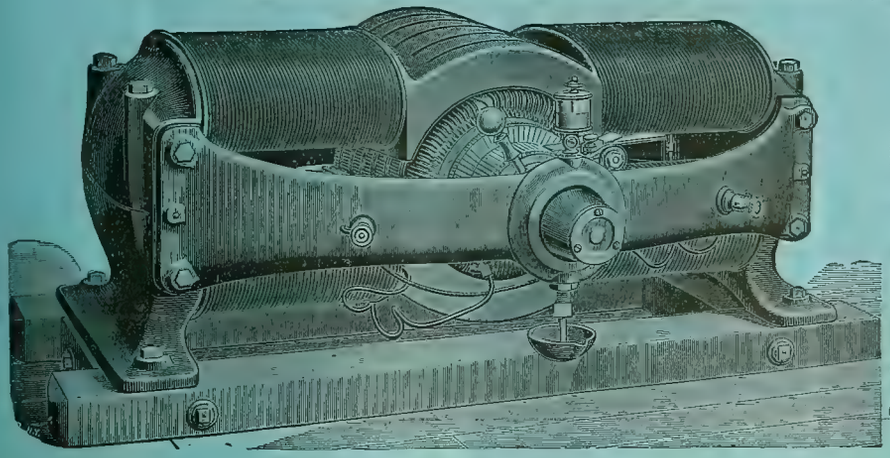

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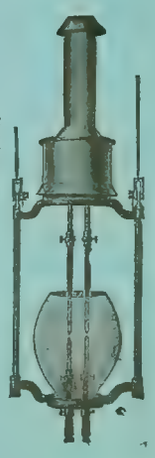

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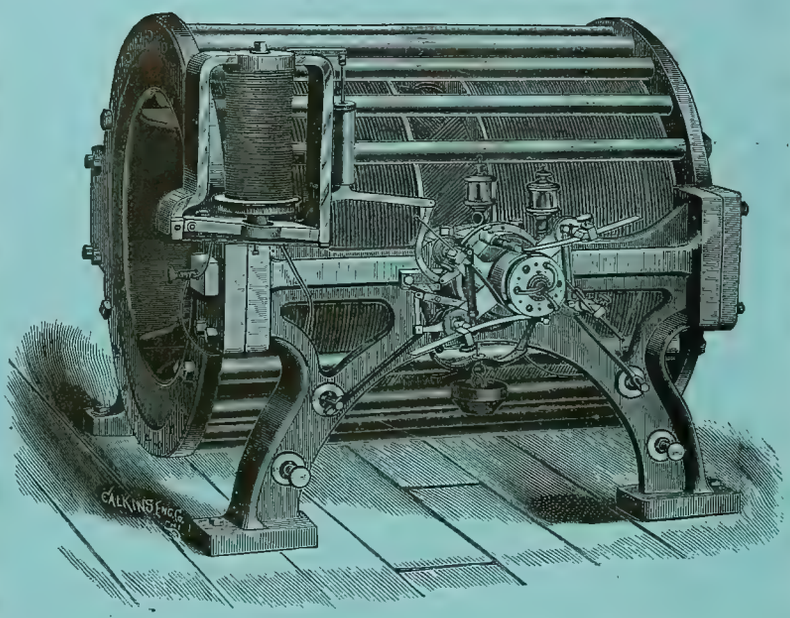

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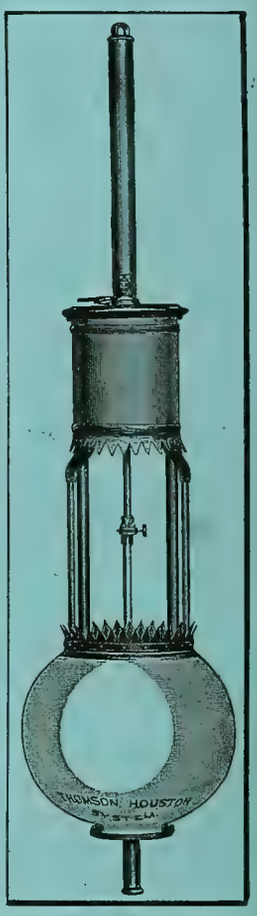

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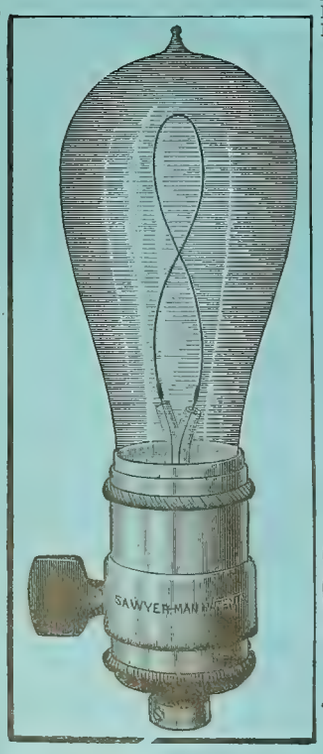

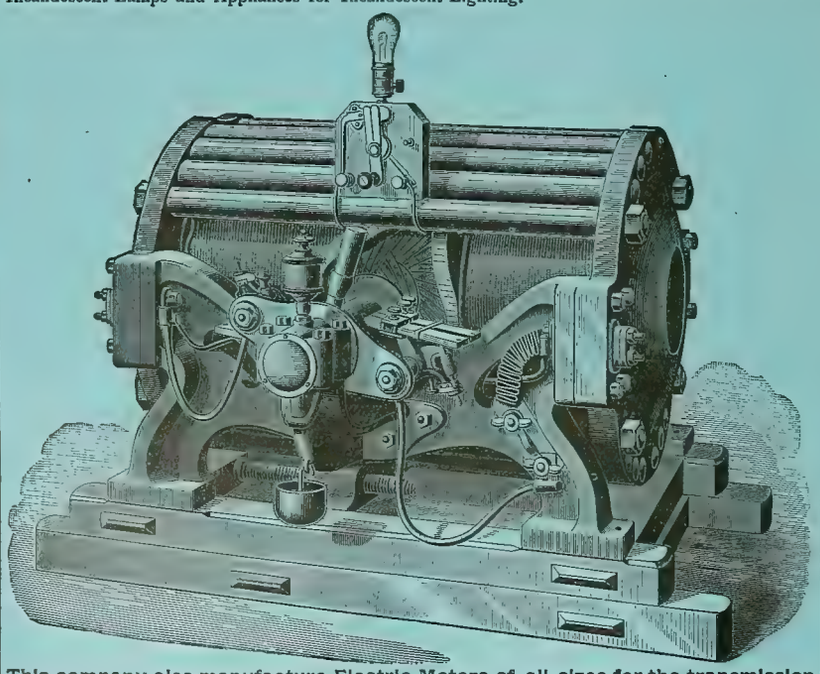

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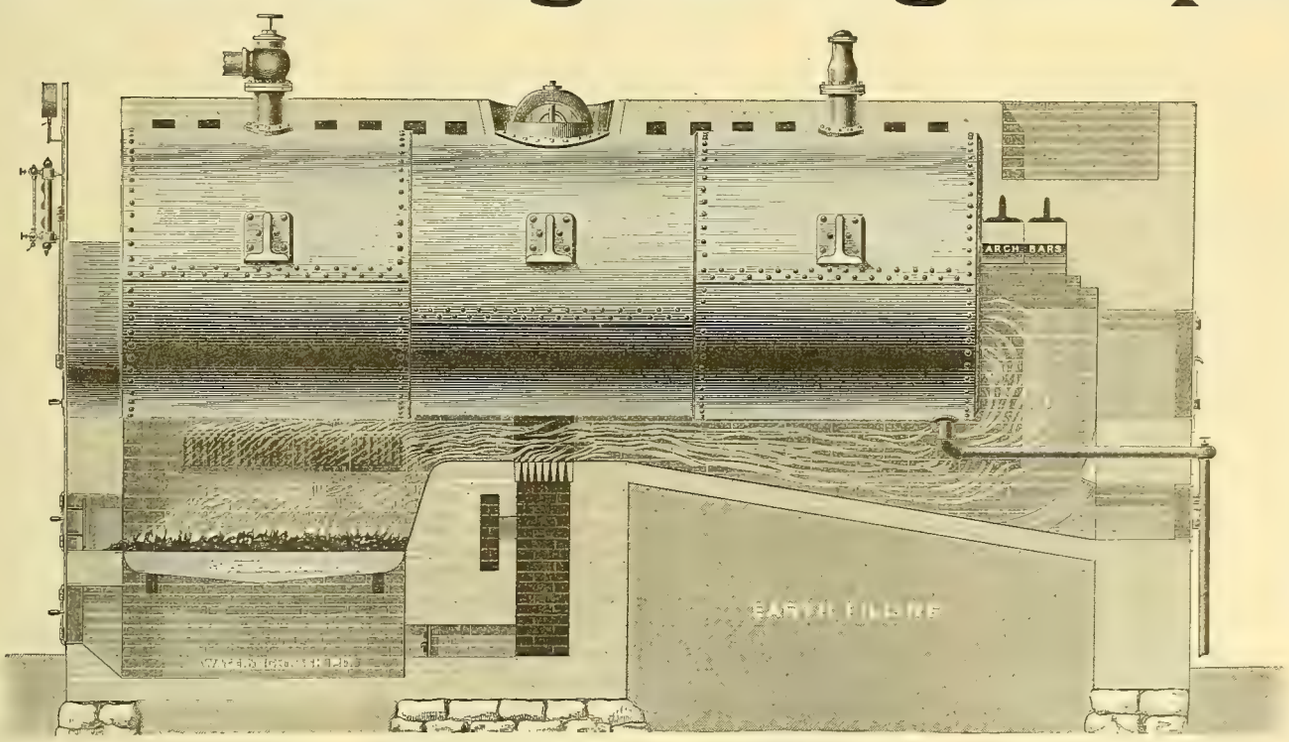

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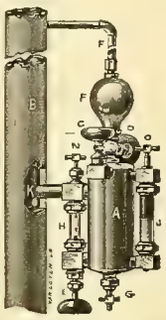

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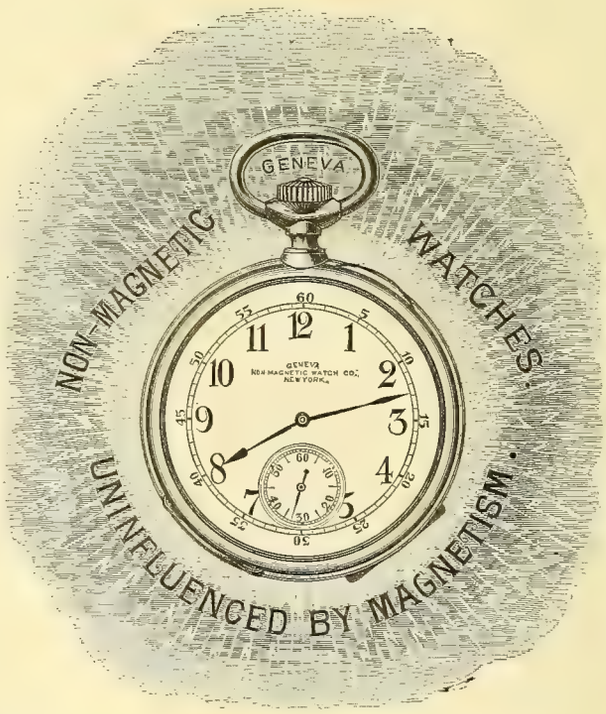

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Complete Steam Plants for Electric Light and Power.

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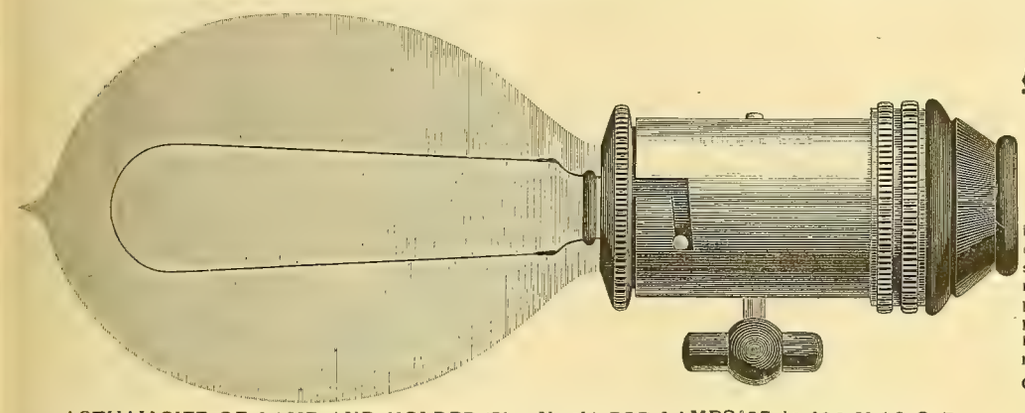
Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

Western Agency, 185 & 187 Dearborn St., Chicago.



ACTUAL SIZE OF LAMP AND HOLDER (Size No. 1,) FOR LAMPS 65 to 100 V. 16 C. P.

Aluminous Incandescent.

We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

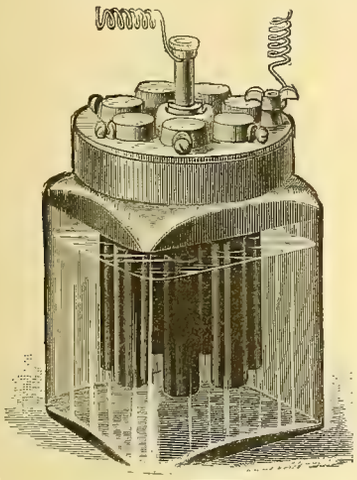
CORRESPONDENCE REQUESTED.
CATALOGUES ON APPLICATION.

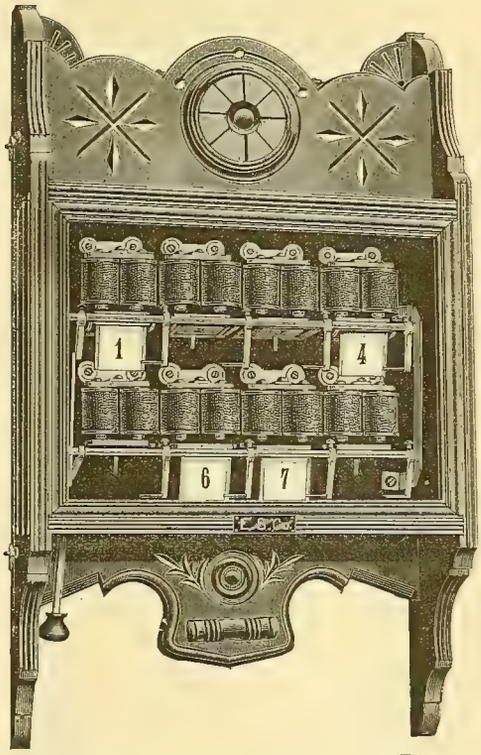
VITRITE & LUMINOID CO., 182 FULTON ST., NEW YORK.

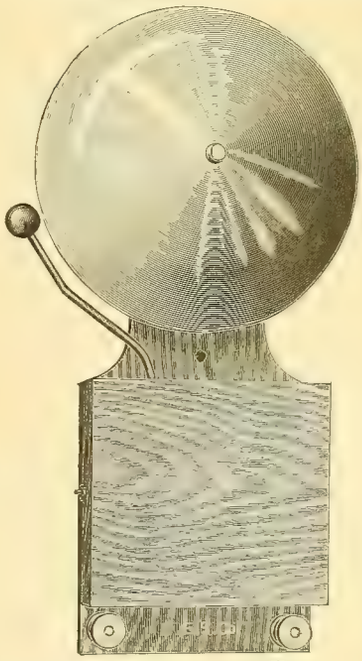
ELECTRIC HOUSE GOODS.

Annunciators, Bells, Batteries, Push Buttons.

A Large Assortment, Thoroughly Well Made.







THE ELECTRICAL SUPPLY CO.,

FACTORIES:
ANSONIA, CONN.

171 Randolph Street, CHICAGO.
17 Dey Street, NEW YORK.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

Telegraph and Telephone Apparatus and Supplies

THE BEST OF EVERYTHING AT BOTTOM PRICFS.

THE EDDY ELECTRIC MANUFACTURING CO.

MANUFACTURERS OF **Automatic Electric Motors** (MATHER PATENTS.)

In all sizes from ½ H. P. upwards. The efficiency of these Motors is over 92 per cent. They require no rheostat, are perfect in regulation, simple in construction, and thoroughly and substantially built. Also manufacturers of

THE MATHER DYNAMO ELECTRIC MACHINE,

FOR ELECTRO-PLATING, ELECTROTYPING, COPPER REFINING, ETC.

These Machines cannot reverse, use no water, do not spark, and are noiseless. Satisfaction Guaranteed.

THE EDDY ELECTRIC MANUFACTURING CO., HARTFORD, CONN.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,
Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.
You will greatly oblige me by answering the following questions.

Yours truly,
C C Warren
MANAGER WESTERN DEPARTMENT,
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously insyalled by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 300 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C C Warren Esq
Dear Sir. I have written the answers opposite your questions above as far as your requests, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me
Yours truly J F Conklin

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, OCTOBER 22, 1887. No. 17.

A New Cautery Battery.

The illustration in connection represents a new battery devised by the McIntosh Galvanic & Faradic Battery company of Chicago, more especially for cautery work in medical practice. The doors and top of the cabinet as shown in the illustration, are open to expose the interior and the engraving so clearly shows the design that little in the way of a letter press description is demanded. The carbon and zinc elements shown suspended by chains running over the periphery of three-quarter segments of wheels are balanced by weights hidden from view at the back of the cabinet. A crank attached to the spindle of the wheels enables the operator to raise the elements out of or lower them into the solution in the glass cells below with great ease. On top of the glass jars there is a protecting plate lined with soft rubber on the under side and vulcanized rubber on the top. Around the edge of the vulcanized rubber small strips of the same material are placed forming as it were a pan. The design, of the latter is to catch the acid that will drip from the elements when they are elevated from the solution, and the design of the soft rubber pad is to prevent the evaporation of the liquid. This protecting plate is removed when the battery is in use.

The solution used is the chromic acid solution. There are fourteen zinc plates and sixteen carbon plates in the elements thus presenting a very large surface to the action of the acid. By the use of two plugs the cells can be coupled together or a current taken from the two cells. By this arragement the electromotive force can be varied to suit the wants of the operator. In some cases, in the use of the cautery knife a current of great volume but low electromotive force is called for and in other cases a current of high intensity is needed.

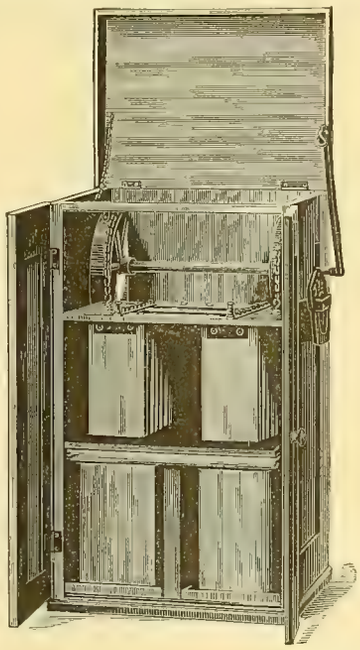
A test of this battery has shown it capable of yielding 30 ampères at four volts.

Electric Safe Lock.

A new electric permutation safe lock differs materially from all other safe locks in the fact that there is no other orifice to speak of in the safe. The dial, which is such a conspicuous feature on the ordinary safe, has no connection in this invention, except by electric wires, with the body of the safe, and may lie on the cashier's desk or repose securely in his home, free from any possible violence of the burglar's hammer. There is, in fact, no limit to the distance that may intervene between the dial and the safe lock, granted that the connection is satisfactory and the battery sufficiently strong. A safe might perfectly well rest in a Chicago office and only be opened by means of a dial in New York. The mechanism is very simple. The dial rests in a magnetic block, from which wires extend and communicate with magnets which set up the tumblers in the lock, and so permit of the throwing back of the bolt bar. This releases a spring or body of compressed air, as the case may be, which in turn releases the heavy bolt-work. The wires penetrate the top plate of the safe at the jamb of the door, and move in a zigzag course through the inner plates to the lock. The wires are so small and their course so crooked that it is claimed they cannot be traced by explosives. A current of electricity is obtained from several small batteries by pressing down a key on the vulcanite block that holds the dial. The dial when not in use can be detached from the vulcanite block and carried in the pocket. The door of a safe whose lock is controlled by this electric apparatus will present to the burglar none of the spindles which penetrate the walls of the ordinary safe and yield so conveniently to the influences of the blow pipe, but simply a knob for opening the door, which only penetrates the first plate.

The Last of the B. & O.

The formal transfer of the property of the Baltimore & Ohio Telegraph company was made at midnight, October 15th, at Baltimore, Md., to the Western Union Telegraph company, which was represented by General-manager Eckert, second Vice-president John Van Horne, General-superintendent Chas. A Tinker and J. C. Wellner and William B. Gill, the latter of Philadelphia. The following order was issued to Baltimore & Ohio telegraph offices after the transfer: "In pursuance of the memorandum of agreement between the Western Union Telegraph company and the Baltimore & Ohio Railroad



company the management of the Baltimore & Ohio Telegraph company outside of the state of Pennsylvania will hereafter report direct to the Western Union offices. There is to be no change at present in the operation of the Baltimore & Ohio telegraph system."

It is reported that the Western Union will move into the operating room of the Baltimore & Ohio, which was especially planned for the purpose and has been pronounced one of the best operating rooms in the country outside of main building of the Western Union in New York.

General-superintendent J. E. Zeublin of Chicago, on the 13th inst., mailed to each of the employes of the Baltimore & Ohio Telegraph company in the western and southern divisions the following letter: "In this hour of great disappointment it is comforting to reflect upon the unity of purpose and personal zeal that has animated the entire B. & O. staff throughout the long conflict that has so unhappily terminated. It may be well to say to the rank and file that I feel confident that so far as they are concerned, conservatism will prevail in the Western Union management, and that, in the still greater contest that company will now have with an indignant public, it will be deemed wise and prudent to endeavor to regain the good will and secure the friendly and cheerful assistance of the expert and enthusiastic employes whose magnificent labors have given to the B. & O. its imperishable glory. Telegraph companies may come and telegraph companies may go, but able, trustworthy telegraph talent will be in demand forever. Fortunately the Baltimore & Ohio has none other. Keep your ranks steady, that we may show to our captors the same grandeur of spirit in defeat that we have heretofore exhibited in successive victories. Let us transfer the service in such condition as will demonstrate that it was handled by capable and worthy hands. While the change may give to some of us slight personal discomfort, I predict that the future will enable every faithful Baltimore & Ohio employe to be proud of the record he made in its service and of the opportunities for ultimate advancement thus afforded. Please accept my sincere best wishes for your temporary comfort and future prosperity. Truly your friend, etc."

Chicago Electric Club.

The Chicago Electric club met Monday evening last for the first time in their permanent quarters over 122–124 Clark street. The committee on new quarters, Messrs. Buckley, Shain and W. A. Stiles, redeemed their promise of having the new rooms in shape for occupancy, although all their intentions in regard to furnishing the rooms had not been carried out. By the time for the next meeting several articles of furniture will have been completed, and the drapers will have carried out their orders in full.

First Vice-president C. A. Brown occupied the chair.

After the reading of the minutes and their usual disposition, Treasurer F. S. Terry presented his report.

Secretary Kreidler announced that with the applications for membership received since the last meeting, the roll showed 148 members.

H. Ward Leonard, of the entertainment committee, announced that at the next meeting B. E. Sunny would read a paper on the inductive effect of electric light wires on telephone wires in their vicinity.

Chairman Buckley, of the committee on permanent quarters, detailed the work of that committee in securing and furnishing the rooms.

F. S. Terry gave notice of offering an amendment to the constitution and by-laws, to the following effect: Any member not paying his quarterly dues within a period of thirty days after the first of the quarter, will be notified of his delinquency by the treasurer. If the dues are not paid at the end of sixty days, his name will be reported at the first business meeting, and the chairman will appoint a member in good standing to confer with him personally. At the first business meeting after thirty days from that date, if the treasurer reports the dues still unpaid, the member will report the delinquent to the club, and the club will decide what action will be taken.

E. P. Warner gave notice that at the first meeting held not less than thirty days from the date of the present meeting, he would move the adoption of the following amendments to the constitution and by-laws:

"Article II, Section 8.—Any person who shall be nominated by the board of managers may be elected an honorary member by a unanimous vote at any annual meeting and shall be exempt from all dues but enjoy all the privileges of other members except voting and holding office."

And to make Article II, section 1 read: "Members shall be classified as resident, non-resident and honorary members."

The first of the foregoing amendments makes provision for the election of honorary members, who had not been recognized in the constitution and the second amendment is a change to make the article of the constitution specified conform to the new admendment proposed.

E. P. Warner then read the paper on "automatic current regulation" reproduced on other pages of this issue.

On motion of C. C. Haskins, a vote of thanks was tendered Mr. Warner for his able effort.

Professor F. B. Badt said, in discussion of the paper, that if reports were true, there was still another method of regulation that had not been mentioned by Mr. Warner. This method, said he, was somewhat similar to that of Gaulard & Gibbs, and consisted in using induction coils in the alternating system. There was another way of getting perfect regulation in the alternating system by connecting arc lamps in parallel and using a converter, but the objection to using arc lamps on a multiple circuit was the expense for wire.

Mr. Sperry had noticed in a system described before the British association, a similarity to that of Waterhouse, referred to by Mr. Warner. The modern theory of the dynamo, he said, was that it had two circuits, one a magnetic circuit, the other a direct circuit. One of the manufacturers of a varied form of the old Gramme machine had suggested that one side of the poles should be short-circuited to a greater or less degree. When it was short-circuited entirely, all the electromotive force of the other coils would be conveyed right on through a closed magnetic circuit, and therefore no particular difference of magnetic potential would occur, and conversely, as the shunt was increased, the magnetic potential would be increased. As was stated in the paper, if the balance between these two is correct, there would be no sparking.

Mr. Warner's understanding of the description spoken of by Mr. Sperry was that the circuit around the variable keeper was regulated by a resistance and not by short-circuiting.

Mr. Sperry said he understood it was by an adjustable shunt, because the windings of the field were in direct circuit.

Professor Barrett, city electrician of Chicago, said: "The conclusion reached by Mr. Warner rather interested me. A short time ago I had occasion to meet a great many electric light gentlemen, and every individual of them had the only perfect regulator. I am sorry to hear the conclusions of Mr. Warner."

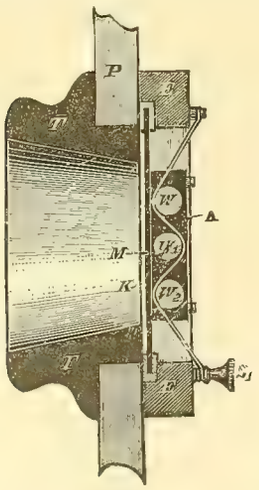


Fig. 1.—A New German Microphone.

The laugh raised by this humorous comment, based upon the professor's experience with the score of gentlemen representing more than half that many companies, all after the contract of lighting the Chicago river, had partially died away when Mr. Warner called the speaker's attention to the fact that he could not have anything so good that he could not have something better.

Mr. Sperry said there were two classes of regulators, one in which there was a central point of rest, like that used in the American system, and the other in which the regulator was in constant operation, like that used in the Thomson-Houston system. He preferred the latter, on the ground that it secured better and closer regulation.

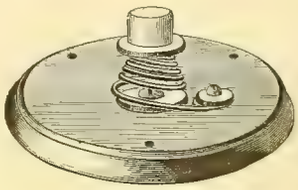
Mr. Warner suggested that there were systems convertible from one into the other. "To say that a regulator has no central point of rest, is not to say that it must work with a relay, and the necessary complications that arise with circuit closing devices."

Mr. Sperry explained that in such a regulator as used in the American system, there must be quite a range of current to overcome the inertia and set the regulator in motion, and that, on the other hand, this objection was entirely overcome in devices which had no central point of rest.

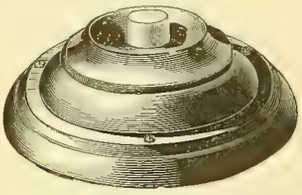
The next meeting of the club will be held the first Monday evening in November—the 7th.

New Style of Push Button.

The accompanying illustrations show a new push button brought out by the Central Electric company, of Chicago. The distinguishing feature of this button is its certainty of action, a rub-



bing spring contact being employed, which is controlled by the pressure of the thumb upon the center piece of the button to which the spring is fastened. No extra screw is needed to fasten the



button to the wall. These buttons are made in metal of highly polished brass and nickel plated, and are manufactured so cheaply that they can be used for inside work to take the place of the wooden button with its semi-circular spring and unreliable contact.

A New German Microphone.

A new microphone has been constructed by P. Jenisch & Boehmer, of Berlin, Germany, which is shown in the illustrations on this page. The diaphragm *M* rests upon the iron ring *E*, which is fastened to a supporting plate *P*, and to this diaphragm are screwed two carbon plates *K*. In these plates three carbon cylinders *W*, W_1, W_2, are loosely laid. The microphone which might appear ready for use even in this form, is improved by having these cylinders held in plates in a peculiar way. One or more threads—in Fig. 2, two threads are shown—*f*, f_1, are wound around the carbon cylinders in such a way that they sustain a pressure in an opposite direction. By this arrangement the carbon cylinders are pressed into their beds in the carbon plates with the requisite pressure, but the pressure on the diaphragm itself is much diminished. The diaphragm for this reason can spring more freely and be made much more sensitive, while this arrangement has no influence on the stability of the entire apparatus. While the transmission of sound is very much improved, it may be remarked that this employment of threads holds the motion of the carbon cylinders within definite limits, and is adapted to the regular oscillations of the tone more closely, by which it becomes possible to achieve great purity in the transmission of tone.

The Western Union company cabled to London the times at which the yachts in the recent race passed Sandy Hook point in seventy seconds—telegraphic speed which has never before been equaled in actual business working.

Signal Service on the Northern Railway of France.

A complete and systematic switch and signal service controls all the trains upon the road. The general apparatus is constructed upon the Saxby and Farmer designs but there are some additions which are peculiar to this road says the *Journal of Railway Appliances*. The principal one is an electric means of communication between the signal boxes. This consists of a large case with a glass front and a number of round holes about 2½ inches in diameter that exposes the interior. When an order for the setting of signals is to be given, electric communication from the next cabin drops a disk before one of these openings, upon which is printed the order to be given. Of course these disks only contain standard orders in constant use, as: "Open switch No. 7." "Close No. 8," or "I close track 4." A bell on the case sounds until the order is obeyed.

Coming into the main Paris station there are three double track lines, each controlled by independent signals, though they are operated from the same cabins. In each cabin there are bells to announce the approach of trains. Two boxes with electric bells are placed in each cabin, one for each track, and they announce the approach of trains from either direction. Thus when a train leaves the station on the Soissons line, the cabin man at the home cabin touches a push button, and in the next cabin the bell rings and a disk drops, making the front of the box to read, "Train coming for Soissons."

As the train passes the cabin, a red and white checkered disk is set over the center of the track and a semaphore arm is thrown out over the cabin. When the train passes the next station the semaphore is dropped by electricity, but the disk, which is a full stop signal, must be taken off by the cabin master. In addition to these means of communication there is also a telephone connection.

In the passenger yard there are two cabins, with 116 and 126 levers respectively, besides a few smaller posts with from four to five levers. Here there is a daily passage of about two hundred trains in each direction, and every switch is controlled by interlocking apparatus. There are no blind switches.

The only feature in which the system differs from those to which we are accustomed is in the elaboration of the electric communications between the cabins. The general design of all the working parts would be familiar to any American railroad man, except that he would find a very marked difference in the weights and sizes. Everything is very much heavier than with us, and seems built for all time. In fact the excessive weights used are sometimes burdensome,

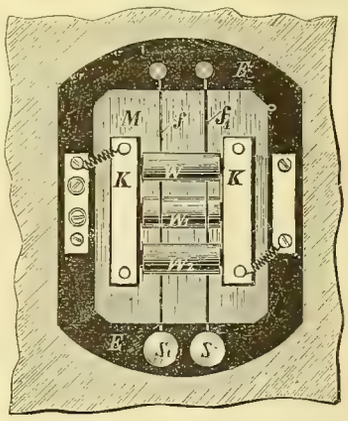


Fig. 2.—A New German Microphone.

and necessitate very heavy structures in order to support them.

Another peculiarity is the use of yellow for a danger signal. They have small auxiliary semaphore arms of yellow, that indicated a closed track, but which are intended more for the guidance of the signal men than the train men. They also use a yellow disk to indicate the setting of a signal and the closing of a track to the cabin men. These little disks are seen through small holes in the boxes in which they appear and require a second examination by the inexperienced eye to detect whether they are yellow or merely a white disk that has become dirty.

Electric Alarm for Railway Crossings.

We reproduce from the *Railway Age* of October 14th, the cuts and a description of an electrical device for sounding danger signals at highway crossings of railroads, adopted by the Pennsylvania Steel company, of Steelton, Pa.

The device is styled a magneto electric generator, and two are placed at the required distance from the crossing, one on each side. For operation and protection the generators are placed in strong water tight iron cases, 16 inches square and 13 inches deep, secured by locks.

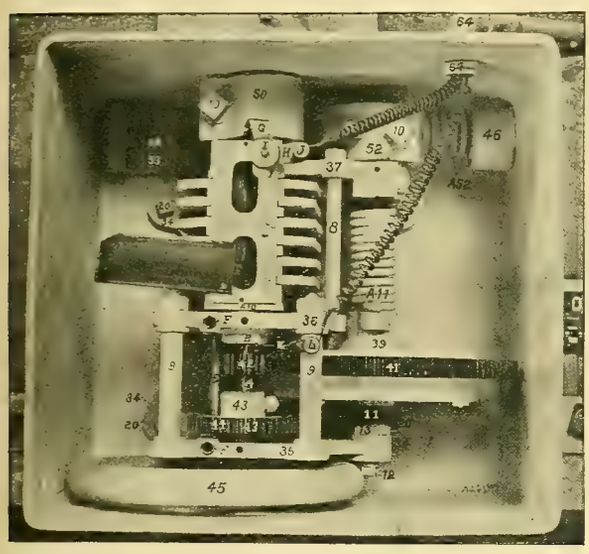


Fig. 1.

The cases, together with the mechanism by which the wheels of the train actuate the generators, are secured upon two track timbers, or cross-ties, about two feet longer than the ordinary cross-ties, in such a manner as to not interfere with the proper maintenance of the track, or renewal of the rails, as shown in Fig. 2. From one side of the iron case a long projection extends toward the track, forming a journal box for a cranked rock shaft, which is connected with the track lever, and conveys into the case for the actuation of the generator, the power derived from the weight of the train. The track lever is strongly made of steel and fulcrumed to a chair, mounted on an iron bed plate, which, extending on the timbers and under the arm extension of the iron case, serves to maintain the position of all the outside mechanism. Every train automatically gives a prolonged warning of its approach, by the action of the generators, whose alternate currents of electricity, duly conducted to the crossing or station, on any fairly good wire circuit, and the actuation of the very simple and substantial apparatus of the gong will, upon

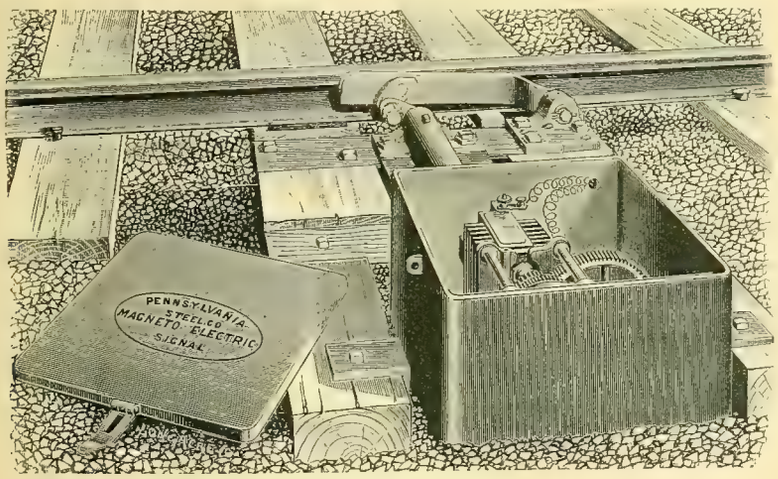


Fig. 2.

approach of the train, give a vigorous and urgent alarm at the crossing.

Fig. 1 reproduces a photographic view of the generator, looking into the uncovered iron case. The permanent magnets and the gearing for revolving the armature are mounted in a strong frame secured to the bottom of the iron case. The armature shaft, 14, is driven by the main gear wheel, 41, and by gear wheel, 43, gives to the fly wheel a much faster speed. The main shaft, 11, has around it a spiral spring, A 11, one end of which is hooked to the frame and the other end hooked to a projection on the shaft, so that a partial rotation of the shaft in one direction produces a tensional and torsional straining of the spring by coiling it tighter, and when the power applied to the shaft ceases, the spring reacts powerfully, uncoiling itself somewhat like a watch or clock spring, the power of the reaction being in proportion to the strain applied when the spring was adjusted. On the main shaft outside the frame is fastened a cam or curved lever, 52, which is provided with a pushing spiral spring, A 52, the two springs constantly tending to press the cam, 52, against the rock lever, 50, which is on the inside end of the rock shaft that connects with the track lever. The lower end of the rock lever, 50, extends near to the bottom of the case, and is provided with a roller which is thus constantly in contact with the cam, 52. An adjustable stop, 53, on the bottom of the iron case limits the movement of the rock lever, and thus regulates the distance above the rail which the track lever may project to about one fourth of an inch. In the main gear wheel, 41, there is an annular recess or chamber, which encloses a silent clutch, 39, or roller ratchet, which is fixed on the main shaft so that when the main shaft turns back, by the movement of the cam, the rollers of the clutch release and the main gear is not moved; the only effect being to strain the springs, but when the main shaft turns forward, by the reaction of the springs, the movement of the clutch makes the rollers wedge and turn the main gear wheel forward, and gives movement to the gearing.

Thus when a wheel passes on to the track lever and depresses it, the sudden strain is applied to the springs, and when the wheel passes off the track lever the reaction of the springs immediately throws up the track lever, and at the same time gives a forward movement of the clutch and main gear operating the gearing. Except for the fly wheel the strain thus suddenly applied would spin the gearing too rapidly and injure it, but the fly wheel gives a yielding resistance, rendering the movement steady at first, and as the wheels successively pass on and off the track lever, the movement of the armature and fly wheel becomes quite rapid, and the momentum acquired by the fly wheel serves to keep it in operation for a considerable time after the train has passed. By properly proportioning the weight of the fly wheel, and adjusting the tension of the springs, and the action of the track lever, it is practicable to secure as long continued action as the distance or other conditions may require. Usually one locomotive, without cars, will produce an action continuing twenty-five seconds.

To convey the electric current to the alarm gong, insulated wires attached lead from the iron case in small iron pipe, placed as low as the bottom of the ties, extending under tracks or otherwise, to the nearest pole, and connect there with the pole wires leading to the crossing.

The electric alarm gong, Fig. 3, which sounds the alarm at the crossing, has all the working parts thoroughly well enclosed and protected from the weather and meddlers, yet very conveniently opened for examination. Where there is a "crossing" sign, as required by law in some states, to be placed at all highway crossings, it may generally be fixed on that sign post, or can be fixed on a separate post, or the side of a building, about 10 or 12 feet from the ground, facing so that the sound of the alarm can go up and down the highway. The electric motors, for striking, are in the upper part of the case. The wire circuits, from the magneto generators, are strung to a pole convenient to the crossing, and thence as shown to the striking apparatus.

The electric motor, by which the alternate electric currents from the magneto electric generators are utilized, to actuate a bell hammer, is a simple instrument. It requires no adjustment of any sort, has no gearing, springs or weights, requires no winding up, has no balancing or sticking point, cannot stop on the center, and utilizes all the electromotive force of the electric currents. In the motor, the respective poles of a series of permanent steel horse-shoe magnets are provided with pole pieces with two inwardly inclined faces, so that the magnetic force in each pole may be used from either one of said faces. Between these inclined faces an electro-magnet

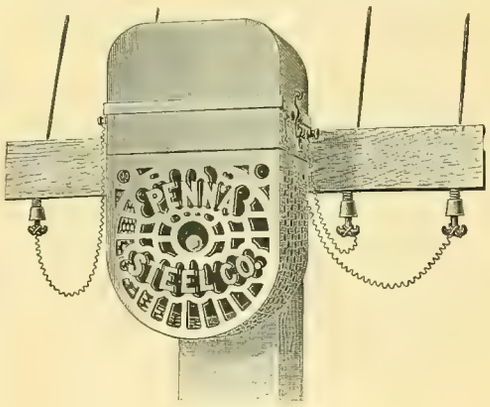


Fig. 3.

vibrates on horizontal pivots, the centers of which are equidistant from the inclined faces of the pole pieces. Each end of the soft iron core having two beveled faces to match the faces of the pole pieces, a limited vibration either way will bring them in magnetic contact. In one position the upper face on the north pole of the permanent magnet will be in contact with one pole of the electro-magnet, while the opposite pole of the electro magnet will be in contact with the lower face on the south pole of the permanent magnet. The ends of the insulated wire wound on the electro-magnet having been connected with the wire circuits from the magneto electric generators, when the armature of the generator is revolved, the electro-magnet will be vitalized by the electric currents thus produced; those currents being alternate, or alternately of opposite polarity, the effect is to make the poles of the electro-magnet alternately north and south respectively, and therefore alternately attractive and repellant to the poles of the permanent magnet, which causes the electro-magnet to vibrate on its axis as often as the armature in the magneto generator revolves. From the lower end of the electro-magnet projects the rod on which is fixed the bell hammer, that by its vibrations, strikes alternately on the edges of the two gong-bells, which are formed suitably to be so struck, the strokes having intensity and power, in proportion to the power of the permanent magnets of the motor and the strength of the currents produced by the magneto generator.

Leather Link Belting for High Speed Machinery.

By Charles L. Ireson.

Electric motors and dynamos exact from the belting with which they are connected, either with their work or their source of power, more than any other belted machinery, the qualities of flexibility, strength and lack of elasticity. The pulleys upon the dynamo or motor are always small, and the belt runs to or from these small pulleys very much more rapidly than in ordinary machinery, because the speed of the dynamo or motor is much higher than the speed of almost every other kind of belted machine, excepting the very rapid machines which are used in light wood working. In consequence of this the belt runs with very considerable rapidity, and takes very short turns; it must, therefore, be more than ordinarily flexible transversely of its length. This quality of flexibility transversely of its length is readily given by dividing the belt into short links which are jointed together at a distance of about an inch between the joints; and these links being made about as wide as the thickness of a double or a treble belt, are practically as strong as the two or three thicknesses of leather which they represent; and while they are almost perfectly rigid, each by itself, when strung upon the wires which make the hinge

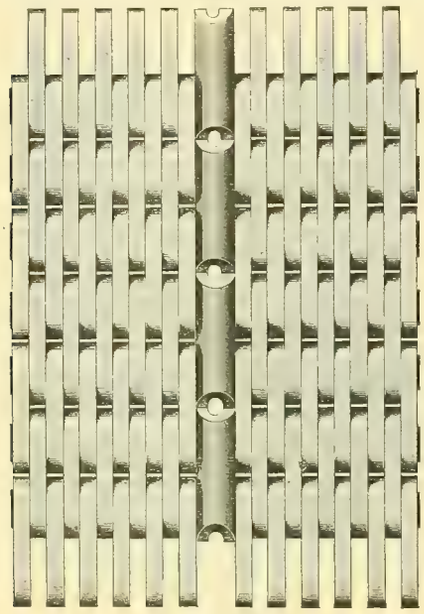


Fig. 1.

joints transversely of the run of the belt, they make a belt much more flexible transversely of its length than it would be possible for a double riveted or cemented belt to be, or even than a heavy single belt. Hence very little power in such a belt as this is wasted in bending the belt around the pulley. Fig. 1 is a view of the top surface of such a belt.

Such a link belt would, however, require a form of pulley unusual in this country, and generally considered a disadvantageous form, namely, a pulley without a crowning periphery, and with lateral flanges to keep the belt from running off. This disadvantage of link belting prevented it from being adopted on machinery generally until extraordinarily strong and extraordinarily flexible belts became essential conditions for the introduction of the electric generator and motor, with due regard to economy. The flanged edge pulley is considered particularly disadvantageous in quick running machinery because of the constant liability to edge friction between the belt and the flange, and hence it has become, within a few years, essential to adapt the leather link belt to the crowning pulley, so that it shall constantly center itself upon the pulley in running, as the ordinary belting centers itself.

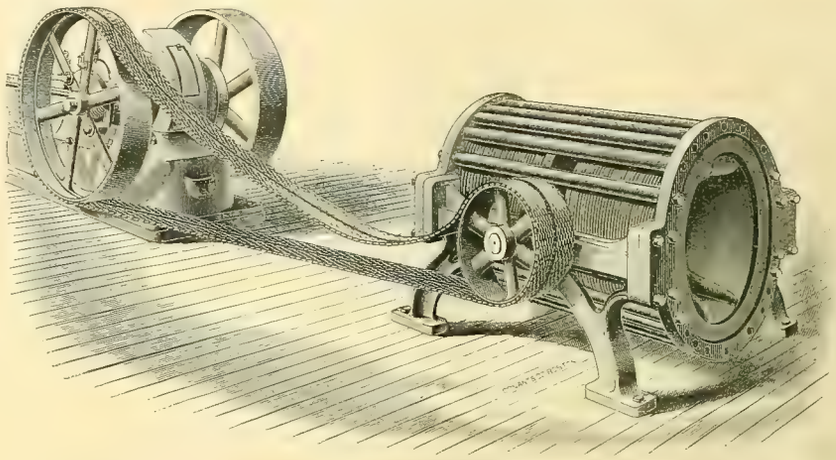


Fig. 2.

This result of adapting the link belt to a crowning pulley was accomplished by James Lee & Sons, of Hipperholme, Halifax, England, about three years ago, and was patented in this country and in England. The device by which the result is accomplished is like most devices which exercise an important influence in the arts, exceedingly simple, and consists in making the belting in two or more longitudinal sections which are hinged together by their edges, as shown in Fig. 3. If made in two sections the hinge rides over the crown of an ordinary cone crowned pulley. If, however, a round faced pulley be used, or the belt is of great width, it is usually better to make the belting in more than two sections, and give it more than one set of longitudinal hinges. By thus furnishing the belting with a series of longitudinal hinges the belt adapts itself to the crown of the pulley exactly as an ordinary belt adapts itself to the crown of the pulley. And in consequence of the fact that the belt is much heavier than the ordinary belt, a degree of slack may be given to the following side of the belt, which enables it to lap the small pulley on which it runs, and thus obtain a friction surface on that pulley very much larger than where a tight belt is used, thus delivering to the operative part of the machine a much greater proportion of the power of the motor than where the contact surface between the pulley and belt is smaller.

These belts, therefore, practically deliver a larger proportion of effective power than the ordinary belt.

The longitudinal hinging of these belts is directly transverse to the leather links of which they are composed, the hinging being practically butt hinging, like the hinges of a door. Another form of hinge has been suggested in which the leather forming the hinge is twisted edgewise instead of bent crosswise to form a less flexible joint along the center of the belt, and in consequence of this, the belt having this central twist hinge is far stiffer and much less easy running than the belt of the precise form invented by the Messrs. Lee. This stiffness prevents the em-

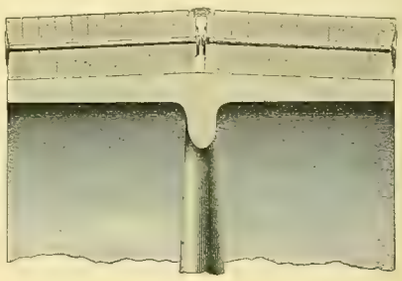


Fig. 3.

ployment to the fullest extent of the advantage of slack, and also requires from the motor considerable more power to be expended in bending the belt.

It is obvious that the interstices of this belt prevent absolutely the formation of air cushion between the belt and pulley, and secure thereby perfect belt contact. The diminished tension employed is a great relief to the bearings of the machinery, and also lessens the destructive strains on the belt, allowing all parts of the belt to rest when they are on the following side. The greater comparative weight of this belt causes it to act as a fly wheel or regulator of the machinery, and thus gives greater steadiness to the work. In consequence of the diminished tension allowable with this belt, it does not require re adjustment when the leather is affected by dampness or heat, as it practically takes up its own slack, and accumulates it all on the following side of the belt.

The proprietor of the patent for this manufacture is Charles L. Ireson, Boston, and a belt of this form, made by him, was seen at the electric exhibition in that city, August 8, 9 and 10, 1887. A Baxter six horse power motor delivered with a three-inch link belt its power to a counter-shaft, from which counter-shaft two four-inch common belts delivered the power to the shaft of a No. 6 Sturtevant blower, rated as requiring six horse power. The link belt was so slack on the following side that in running from a five-inch pulley to a twenty-four-inch pulley, which were set about eight feet apart on the centers, there was a sag of about ten inches from the straight line which would have joined the highest points

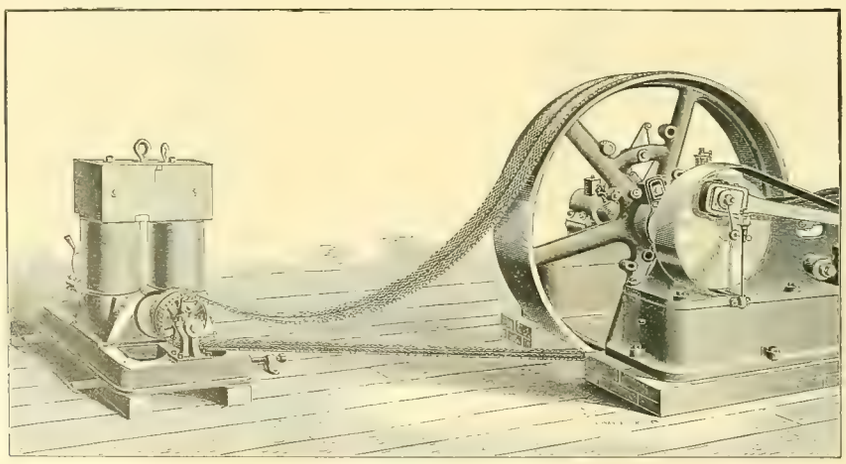


Fig. 4.

in the crown surface of the pulleys, the sag of the belt bringing the lower part of it within four inches of the hauling side of the belt. In consequence of this sag the lap of the belt on the small pulley was more than a semi-circumference, while with ordinary belting this lap would have been somewhere from a quarter to a third of the

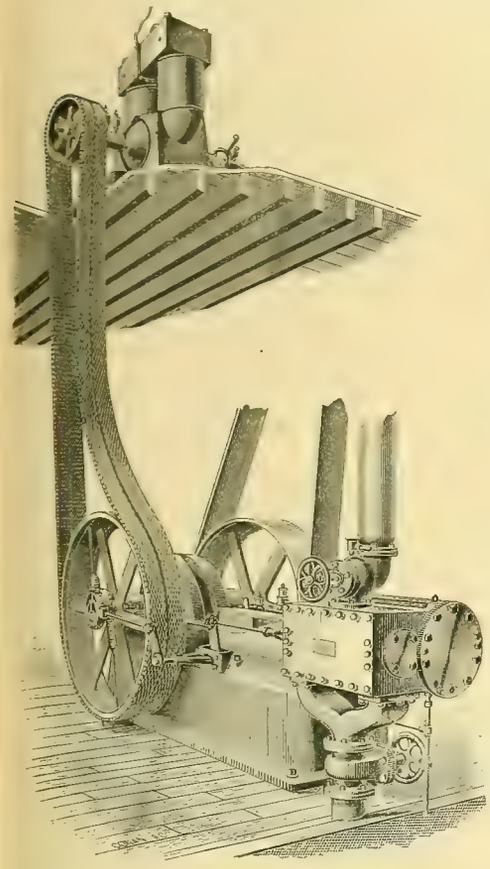


Fig. 5.

circumference. As a result of this there was no slip, and a much narrower belt could be used than if frictional contact between the belt and the pulley had been required to be made by the width of the belt instead of by the length of the belt.

It was at first thought that these belts would be useful only on slow running machines, but experience has shown that they are far more desirable on machinery that runs at high velocity.

Fig. 2 shows a belt that is in use at the Boston Electric Light company station, at 197 Congress street, put in September, 1886. The speed of the engine is 285 revolutions per minute, of the

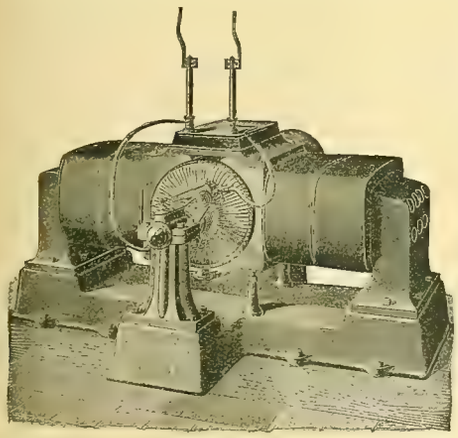


Fig. 40.

dynamo 893 revolutions per minute, and of the belt 3,507 feet per minute. As will be noted the belt contact is about twenty per cent. greater than can be obtained by an ordinary belt.

Fig. 4 shows a belt running the electric light plant of the Bradley Fertilizer company at North Weymouth, Mass. The data and conditions of use are appended:

8 inch self-adjusting link belt conveying 25 H. P.

Length of belt in feet,	30 1-2
Diameter of fly wheel in inches,	62
Diameter of dynamo pulley in inches,	11 1-2
Speed of engine, revolutions per minute,	260
Speed of Dynamo, revolutions per minute,	1,400
Speed of belt, linear feet per minute,	4,220
Distance from center of engine shaft to center of dynamo shaft,	10 feet, 6 inches

Fig. 5 shows a vertical belt in use at the Edison station, in Head place, Boston, Mass.

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number XIV.

The Van Depoèle Dynamo.—The general construction of this dynamo is shown in Fig. 40. The cores of the field magnets, made of wrought iron, are bolted to the cast iron base, thus forming a single magnet with inverted poles facing the center, and terminating in the pole pieces which are supported on the base, and between which the armature is placed as shown. A wooden plate, resting on the magnets above, serves as a support for the binding posts, which connect with the outer circuits.

The armature is of the Pacinnotti-Gramme type; its core is composed of layers of soft iron wire, coated with zinc, and thus magnetically insulated from each other, forming a helix supported on longitudinal bars, and divided into sections separated by wooden strips for ventilation.

The special distinguishing feature of this dynamo, according to the latest construction, is the differential winding of its field magnets, and their connection with an external current regulator, by which the volume of current is increased or diminished automatically, as required by the varying resistance of the external circuit.

In Fig. 41 the dynamo is shown in section, and the regulator and lamp circuit above it. AA^1 is the core, MM^1 the helix connected with the main circuit, and DD^1 the helix of finer wire connected with the differential or shunt circuit; the two circuits being wholly insulated from each other, and so connected that a current passing through the differential or shunt circuit opposes the current in the main circuit. The current entering from the lamp circuit at P traverses the left exterior helix, enters the armature by the upper brush at B, leaves by the lower brush at C, enters the right exterior helix at C^1, leaves it at D^2 and passes from the binding post N to the electric magnet M^2, and circulating through its coils leaves at F, passes through the lamp circuit $G\,H^1$, and returns by the wire I to P.

The current in the shunt circuit enters from P at A^2, traverses the left helix, leaves at b and passes by the wire b^1 to c, traverses the right helix, leaves at d enters the regulator at P^1, leaves at N^1 and returns to N.

Now, since the current in the main circuit leaves at N, and the current in the shunt enters at N, it is evident that these two currents are in opposition; but in the normal condition of the lamps the shunt is out of connection and no current passes through it, but when one or more lamps are extinguished, the volume of current in the main circuit is increased by the reduced resistance, the armature of the magnet M^2 attracted, the copper bar H drawn down in opposition to the spring S^1, and contacts made with the resistance coils $f\,f$, at the points $g\,g$, through the platinum strip h; and the opposing current flows through the shunt as described. This current flowing in a fine wire circuit and through resistance coils, is just sufficient to reduce the current in the main circuit to its normal volume; its quantity being regulated by the number of resistance coils through which it passes. The contact points $g\,g$ being of different heights, the flexible platinum strip is brought into contact with a greater or less number of them, in proportion to the increase or decrease of current in the main circuit, and this is regulated by the spring S^1, whose force can be adjusted as required by the set screw shown in the cut.

The Westinghouse Dynamo.—This is an alternate current machine, designed solely for incandescent lighting. Fig. 42 is a perspective view from which the construction will be easily understood. The field magnets, bolted to the external frame of the machine, form a circle, radiating inwards toward the armature which is mounted in the center on standards rising from the base. They are of elliptical form, the longer axis of a cross section each core being parallel to the armature shaft. The winding of each magnet is opposite to that of the adjacent one, so as to produce alternate north and south polarity. The coils are slipped on the cores after being wound.

The armature core is composed of sheet iron rings insulated by paper, and having tubular openings for ventilation, parallel to the axis. The winding differs from that of the Gramme

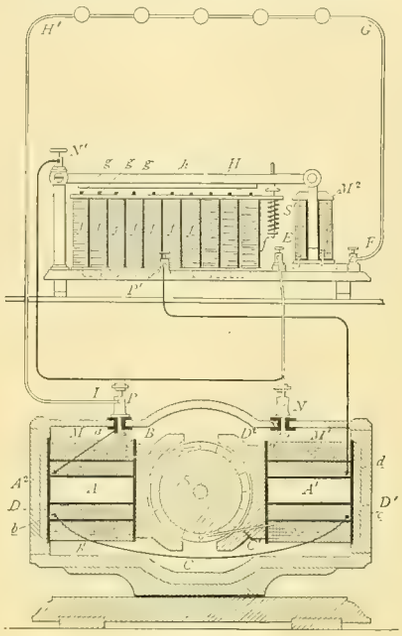


Fig. 41.

armature in having no interior wire. The coils consist of of single layers of wires, wound on the external surface of the core, and looped around projections at the ends, attached to non-magnetic rings; so that the planes of the coils are at right angles to the radii of the armature, and there are no crossing wires at the ends, as in the Siemens, nor wire in the interior of the ring as in the Gramme; the ends being exposed for ventilation through the tubular openings in the core. Adjacent coils being wound oppositely as in the field magnets generate alternating, opposite currents. The coils are insulated from the core with mica, and also covered externally with the same material. The entire weight of copper wire on the largest armature does not exceed sixteen pounds.

The space between the armature and field magnets being only $\frac{3}{16}$ of an inch, and there being only a single layer of wire on the armature

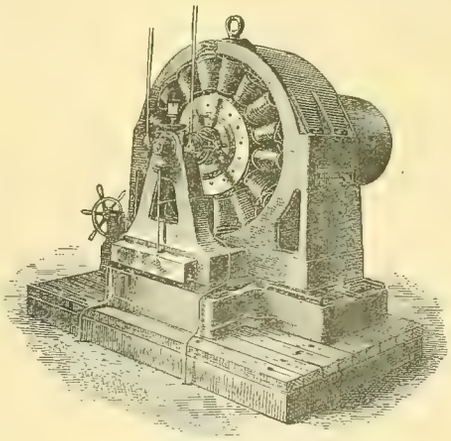


Fig. 42.

surface, both the coils and the core are in close proximity to the field magnets, and hence the magnetic and electric reciprocal actions are at the maximum, and there is no dead or partially inactive wire in the interior; all the wire, except a very small percentage on the ends, being exposed to the full action of the magnetic field.

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General Eastern Agency.

We take pleasure in announcing that we have secured the services of W. J. Armstrong as general eastern representative, with headquarters at 181 Broadway, New York. Mr. Armstrong needs no introduction to the electrical fraternity, his long connection with the Western Electric company having given him a wide acquaintance, especially in the east. Mr. Armstrong will give the paper his entire time and attention, and will regularly visit the different eastern cities. We feel sure our many eastern friends will be glad to know that their interests are hereafter to be so closely looked after by the only western electrical journal, and we can assure them that anything in the way of news articles, subscriptions or advertising entrusted to Mr. Armstrong will receive prompt attention.

THE ordinance which virtually imposes a tax of ten dollars on each telephone in use in Chicago was reported favorably by the committee on judiciary of the city council at the meeting last Monday night and was ordered published.

THE absorption of the Baltimore & Ohio Telegraph company by its great rival the Western Union Telegraph company, has already given new life to the movement looking toward the government control of the telegraph. Senator Wilson, of Iowa, has had a bill to that effect in several congresses and Senator Edmonds, of Vermont, was a supporter. Through the latter's efforts the bill was reported favorably by the post-office committee, but it was never reached on the calendar.

THE new form of microphone shown on another page possesses merit enough to warrant its reproduction from our German contemporary *Elektrotechnischer Anziger*.

The reader will see in this somewhat of a resemblance to the Mix and Genest microphone illustrated in No. 11 of the WESTERN ELECTRICIAN. The essential difference between the Mix and Genest microphone and that shown in this number consists in the employment of a spring in the former and threads in the latter for holding the carbon rollers in place. Special stress is laid upon the simplicity of the apparatus and the certainity with which it works, inasmuch as the threads shown entwine the three carbons taxing them equally.

Every new device for lessening the danger on railroads will be welcomed, and the electric alarm for railroad crossings, described on another page, adds another to the many similar devices already tried. The imperative necessity of protection at street crossings, especially in large cities, becomes more urgent as railroads multiply and cities increase in size. Accidents in Chicago are becoming alarmingly frequent, and the public demand for faster time on suburban trains, and the disposition of the railroads to accede to it, is likely to increase the danger very materially; speed has thus far been limited to six miles an hour, but it is proposed to increase it to fifteen miles, and it will probably be increased eventually to thirty miles, if proper protection can be afforded. The mayor and the railroad companies are both fully awake to the importance of ample protection, and the facility with which electricity can be applied, and the rapidity of its action, especially adapts it to the requirements in this case. Where street crossings with numerous tracks intersect, and trains in opposite directions are constantly passing, the most vigilant flagman cannot wholly avert danger, and automatic devices operated by the passing trains, are the only sure reliance.

THE scope of the current issue of the WESTERN ELECTRICIAN well illustrates the frequently mentioned activity in the electrical field. Even well posted electricians who are supposed to keep pace with the developments in this department of industry will find much to interest them. In the way of illustrated articles, we show a new style of battery, a new microphone, even a new form of push button; then a method of sounding an alarm at railway crossings; follow with a description of belting adapted to high speed engines for electric lighting, and continue the illustrated treatise on the elements of electric lighting. In Mr. Warner's paper and the report of the proceedings of the American Institute of Electrical Engineers in New York, there are many points of interest and information, while the bright and newsy correspondence from different electrical centers notes the progress that is being made in other places.

In a quiet but effective manner steps are being taken in Chicago towards lighting at least the main business streets by electricity, the city to own and operate its plant. The feeling in the city council toward the movement is said to be favorable, and naturally enough Professor Barrett, the city electrician, is strongly in favor of it.

No valid objections can be raised against the plan, while many points can be cited in its favor. At the price charged for street gas lamps, even the most liberal estimates of cost, both initial and for maintenance, show a saving well worth the consideration of the city financiers. It is hardly necessary to refer to a comparison of the electric light and gas light for street illumination, for the superiority of the former is universally recognized. The fact has been brought out in New York that the extension of street lighting by the powerful arc light has actually wrought a decrease in crime, and there are certain sections of Chicago where a similar decrease should be made, even if the expense were many fold greater than that entailed by the introduction of the electric light.

Undoubtedly the successful operation of the river lighting plant now being constructed will have considerable influence upon the adoption and installation of a general street lighting system. And as that plant promises everything in the way of success, it will probably not be long before definite measures will be taken by the city authorities to install and operate a plant to light the streets.

THE paper on automatic current regulation, read at the last meeting of the Chicago Electric club, by E. P. Warner, which we publish, gives a concise, connected history of the various devices for this purpose which have come into use, and their comparative merits and success. The subject is one of great importance, and the paper shows that, while much has been done, much yet remains to be done, before any system can be so far perfected as to be entirely satisfactory. Still it is encouraging to know that good, practical results have been obtained, and many of the obstacles met with in the earlier attempts surmounted.

When electric lighting was first introduced into Chicago, seven years ago, we had what might appropriately be termed the pole system of regulation. When one lamp in a series became dim or was extinguished, and the others blazed out fiercely, a long pole was used to adjust the carbons in the offending lamp and restore the equilibrium, and the clerks in business houses where the arc lamp was introduced as an advertisement, were often kept as busy waiting on the lamps as on the customers. Now the system of regulation is such that the extinguishing of one or more lamps in a series makes scarcely any perceptible difference in the light of the remaining lamps.

WEDNESDAY evening, October 12th, a fire occurred in the insane asylum at Cleveland, O., and seven women patients were burned to death, while three more were so frightfully burned that death would have been welcomed as a relief to their sufferings. The cause of the fire is supposed to have been leaking gas.

A thrill of horror is awakened at the thought of a fire in a building occupied by human beings bereft of that reason that would otherwise teach them to seek some way leading to safety—poor demented creatures whose clouded senses recognize no signals of warning or signs of danger. Humanity teaches that extraordinary precautions should be taken for the safety of those who are for any reason confined within walls or behind bars. In the present instance there is no evidence that to dereliction of duty can the prime cause of the fire be laid. Nor was there any dereliction of duty to be charged with the fire in the state industrial school at Rochester, N. Y., a winter or two ago. Nevertheless, fires occurred in both institutions, though the loss by death in the flames was much less in both cases than might have been expected. It follows then that even in the best regulated institutions, where persons are for any cause confined, fires may occur, and that being the case, that extraordinary precautions should be redoubled. If the safe electric light had been burning in the Cleveland institution and no gas been in the building, there could have been no leaks to originate a blaze.

THE discussion of Professor Forbes' paper on his coulomb meter by the American Institute of Electrical Engineers at its last meeting, Oct. 11th, will be found on another page. In a similar discussion by the British association, at Manchester, the invention was highly commended by Sir William Thomson, Professor Perry and others for its extreme simplicity, cheapness, and scientific adaptation to the purpose for which it was designed. This commendation was the more remarkable from the fact that both Thomson and Perry have similar devices of their own, to which they have devoted a great deal of time and attention; and Sir William went so far as to say that Professor Forbes' instrument so far excelled his, especially in simplicity and cheapness, that he would probably abandon his own except for some special uses.

The instrument is constructed entirely on the principle of the heat generated in a wire by the electric current; this heat creates ascending air currents, by which a little horizontal wheel with mica vanes is rotated, and this puts in motion a light train of clock-work, by which a record on a scale is indicated, the instrument being covered with a glass shade to protect it from external air currents.

In the discussion before the American Institute, the question was raised, and pressed quite earnestly by one of the speakers, as to whether the accumulation of heat in the top of the shade would not produce partial equilibrium, reduce the speed of rotation, and cause a false registration, and whether this might not be avoided by a small hole in the top for ventilation. Professor Forbes replied that as a matter of fact the heat accumulation did not affect the speed of rotation, and that ventilation was therefore quite unnecessary, and any opening in the shade detrimental to success.

Mr. Weston, whose experience in the use and construction of meters seems to have been very extensive, commended this instrument in the highest terms, stating that, as a matter of fact, all the numerous meters heretofore invented, his own included, were very unsatisfactory, and most of them practically worthless, while this simple, delicate little instrument could measure accurately weak currents or powerful ones, constant or alternating.

Automatic Current Regulation.[1]

By E. P. Warner.

The title "automatic current regulation" is rather comprehensive and may reasonably be held to include all automatic regulation of current whether, upon single or multiple circuits. It is my intention, however, to limit this paper to a brief consideration of the various systems of regulation used to maintain current constant over a single line. While but a superficial treatment of the subject without entering closely into constructive details at any point, it will, I trust, prove sufficiently interesting to have merited your attention.

Previous to the discovery of the dynamo electrical machine in 1866, a number of attempts had been made to secure automatic regulation. Siemens, Hospitalier, Regnard, Sir William Thomson and other scientists of recognized ability had experimented with variable rheostats controlled by electro-magnets and platinum wires operating through expansion, to vary the resistance in circuit and thereby hold current constant. One of the most perfect devices consisted of two clock trains controlled by an electro-magnet placed in the circuit upon which it was desired to regulate current. Any decrease in current operated through the movement of the armature of the electro-magnet to allow one of the clock trains to start and move the lever of an adjustable rheostat in such a direction as to reduce its resistance; this it continued doing until the current was restored to a certain point, when the armature of the electro-magnet would be drawn up and stop the clock train. An increase of current operated to start the other clock train, the office of which was to shift the lever of the adjustable rheostat in the direction required to increase resistance until current reached its normal strength when the train would be stopped as before mentioned. This apparatus was found, under favorable conditions, to maintain the constancy of current within quite narrow limits. Where simply an electro-magnet and armature or platinum wires were used to directly operate a variable rheostat, the results were of a very unsatisfactory nature, for the reason that with a constant value of C the magnetic movement of the electro-magnet, as also the heating of the platinum wire, must remain constant. It is therefore manifest that no proper adjustment of the variable rheostat could be made in this way. If we look at these methods of regulation from the standpoint of efficiency we see that their use must, to a greater or less extent, affect the conditions of maximum efficiency, a certain portion of the output of the generator being sacrificed for the purpose of regulation.

With the advent of the dynamo electrical machine there arose a pressing demand for some practical means of automatically regulating the current supply. Numerous inventions have resulted varying, over a wide range, in their operation and utility. Before proceeding with a description of the various systems of regulation it would perhaps be well to briefly mention some of the causes of irregularity in current.

In the case of a dynamo electrical machine supplying a number of arc lights in series, variations of current may be occasioned by either of the following:

First, changes in speed of rotation of the armature.

Second, changes of circuit resistance whether internal or external.

Third, changes in strength of magnetic field.

It is, of course, possible for two of the above causes to operate simultaneously either with or against each other. One of the earliest experimental devices for maintaining the current constant over varying resistance consisted of an electro-magnet connected in the main circuit, having an armature lever so connected to the governor of the driving steam engine as to operate to increase the speed of the engine, and consequently of the dynamo armature, directly as the resistance of the circuit increased, or, on the other hand, to diminish the speed as resistance decreased. The origination of this scheme is credited to Fennel and Richardson, of England, who experimented from 1879 to 1881. In 1880 H. S. Maxim, of Brooklyn, N. Y., devised an apparatus of a now well-known and distinct type. In the main circuit of a dynamo electrical machine was included an electro-magnet with an armature and lever operating through mechanical connections to shift the brushes around the commutator of an auxiliary series dynamo, the current from which was used to excite the field magnets of the main or larger dynamo; a movement of the brushes forward resulted in a reduction of current and consequent weakening of the field of the large dynamo; a movement of the brushes in the reverse direction gave an increase of magnetic intensity. The action of this regulator apparatus was rather unsatisfactory. In practice it was found that the current from the auxiliary dynamo could not be changed as desired without destructive sparking on the commutator. The resistance of the main field magnet coils being unvarying and the speed of the auxiliary dynamo constant, the brushes would only run free from spark at one particular point. Certain features of construction in the main dynamo also interfered with the operation of the regulator.

In speaking of this apparatus as of a well known type, I have in mind the class or type of regulators that operate by varying the strength of the field magnets. In this class may also be included the regulators of Charles F. Brush, of Cleveland, Ohio, and Edward Weston, of Newark, N. J. In the Brush regulator, the field magnets of the dynamo are excited by the direct current of the main conductors; a shunt of variable resistance is connected across the magnet coils whereby any desired amount of the current may be diverted from the coils, the ampère turns reduced and field magnets weakened. The variable resistance consists of a pile of carbon plates connected in series in the shunt circuit; a solenoid, compound wound, is provided, the coarse wire or inner coil being connected directly in the main circuit, while the outer or fine wire is in series with the carbon resistance pile and shunt circuit. The iron core of the solenoid is connected to a lever arranged to bring pressure on the carbon pile as it is drawn upward. As current rises or falls, owing to variations of circuit resistance, the solenoid varies the pressure on the carbon pile and therefore the resistance of the shunt circuit, the idea being to so vary e. m. f. as to maintain current constant. This apparatus does not seem to be capable of regulating over a very extended range, but serves within reasonable limits to regulate current; should the resistance of the circuit be lowered the resulting increase of current immediately draws up the iron core, increases pressure upon the carbon pile, reduces shunt resistance, and weakens field magnets until e. m. f. has fallen so as to nearly reduce current to its former strength; the increased pressure upon the carbon plates must, to a certain extent, be maintained, and to assist in doing this is the office of the fine wire of the solenoid which as I have stated, is included in the shunt circuit. It is apparent, however, that care must be taken in applying the shunt coil to this use, as it operates to reduce the resistance in its own circuit and thereby increase its own current. It must also be properly proportioned coarse wire, or main coil to ensure good work. As a rule, when any great change of load is to be made on a Brush series dynamo, such as cutting out a large number of lamps, the commutator brushes require to be shifted forward by hand to reduce e. m. f.

The Weston regulator used by the United States Electric Lighting company consists of a variable resistance placed in the shunt circuit of a shunt wound dynamo. An electro-magnet placed in the main circuit controls a mechanical shifting device that serves to either increase or decrease the resistance in the shunt circuit. This resistance must be held at such a point that the current in the field magnet coils will just raise them to the needed magnetic strength to give the proper e. m. f. to maintain the desired current. A decrease of circuit resistance will therefore call for a corresponding decrease in strength of magnetism of fields, while an increase of circuit resistance calls for increased magnetic field. In this system of regulation, the field magnet cores must never reach saturation, and, as a consequence, they are quite sensitive to current changes. As a rule, they give the best and most stable results when a full load is on the dynamo and the fields are magnetized to their highest point. This system of regulation has never been successfully applied to any of the so-called high tension systems, although experiments have been tried by Wm. Hochhausen and others. Hochhausen tried winding the field magnets of a series dynamo in sections, so arranged that the automatic regulator cut in or out the sections as desired. The very unstable nature of the high tension arc, and extreme sensitiveness of the field magnets when not charged to saturation, made it nearly an impossibility to control the apparatus or render is stable under all loads.

Numerous ingenious devices for automatically shifting the brushes upon the commutator of a dynamo to effect current regulation, have been brought into use during the past five years. Elihu Thomson and Wm. Hochhausen were active in developing this class of apparatus, and it is now very extensively used. It has been found that with certain kinds of armature, either open or closed coil, a perfect regulation of current could be effected by simply shifting the brushes around the commutator to suit the varying resistance. When the proportions of wire to iron and their disposal with reference to each other are correct, such a method of regulation does not increase sparking at the brushes or occasion undue heating.

In the regulator devised by Elihu Thomson, a double solenoid placed in the main circuit is provided with an armature having a circuit-closing device attached, which closes or opens a shunt around an electro-magnet also in the main circuit. When the shunt circuit is open, the electro-magnet is, of course, energized, and starts moving the brushes forward and reducing the current until the solenoid—commonly called a wall-controller or relay—operates to close the shunt, whereupon the magnet is de-energized, and permits the brushes to be moved back by the action of a spring or weight until the increased current causes the relay to again open the shunt circuit. This opening and closing of the shunt circuit occurs with greater or less frequency, according to the demands of the circuit. For instance, should a considerable decrease of circuit resistance be made, the relay would operate to hold the shunt circuit open until the electro-magnet had thrown the brushes far enough forward to make a proportionate reduction of e. m. f., or until the normal current was again reached, when it would rebegin its work of alternately opening and closing the shunt circuit, the rate in this case being determined by a dash pot adapted to retard the action of the electro-magnet. This apparatus, while rather complicated, is capable, when properly adjusted, of giving a sufficiently close regulation of current for arc lighting purposes, the continuous rise and fall producing no appreciable effect upon the lights.

In the regulator of Wm. Hochhausen a small electro-motor is sometimes used to move the brushes around the commutator, a relay in the main circuit operating to send a portion of the current from the main conductors through the motor in such a direction as to cause it to move the brushes in the proper direction. Hochhausen also made use of a mechanical brush shifter driven by friction gearing from the shaft of the dynamo. Two electro-magnets included in the main circuit were so arranged that the relay also in the main circuit could short-circuit either of them, then leaving the other free to act upon an iron armature placed between their poles, one magnet operating through the friction gear to move the brushes forward, the other through separate gear to move the brushes back.

It has been found possible to dispense with the use of a relay and contacts, and make a properly proportioned electro-magnet in the main circuit act directly to control the mechanism used to shift the brushes, power being obtained from the dynamo shaft through belting. Regulators operating on this plan are used by the Western Electric company, of Chicago, for their arc lighting system. They are also used, I think, by the Fort Wayne Jenny Electric Light company. The results obtained vary, of course, with the different mechanical devices used. It is a difficult matter to so proportion an electro-magnet that it will perfectly respond to changes of current, the magnetism lagging behind current both in ascending and descending.

In the regulating apparatus, patented by J. H. Irwin, in 1882, the armature of the dynamo

[1]Read before the Chicago Electric Club, October 17, 1887.

is moved laterally out of its position between the poles of the field magnets, thus reducing the active wire upon the armature, and in turn the e. m. f. and current; the field magnets are in series with the armature, and the expenditure of electrical energy required to excite them is therefore constant. The great length of the armature shaft, inertia, and probably numerous other difficulties encountered in practical use, have prevented the adoption of this system of regulation.

Automatically operated devices for moving the poles of the field magnets toward or away from the armature have been tried, but the results obtained have not been encouraging. Attempts have been made by inventors to regulate by moving the field magnet poles around the armature, leaving the brushes stationary. I do not learn that any good results have been obtained, but see nothing in the scheme to warrant very unfavorable comment.

Another arrangement of apparatus for regulating current is commonly known as the magnetic short-circuit, its operation depending on the action of a keeper or iron bar placed across the poles of a dynamo, to divert a portion of the magnetic lines of force from their usual path through the armature core, thus reducing the e. m. f. In this case the automatic regulator causes the keeper to approach or recede from the poles according to requirements. In this class may be included the regulators of F. G. Waterhouse and H. W. Ravenshaw. In this class of apparatus, use is made of a combination of series and shunt winding, the shunt coils operating upon a keeper of iron placed across the poles to oppose the lines of force which tend to pass, the degree of opposition increasing directly as the resistance of the circuit until maximum load is reached, when the keeper will be found acting in conjunction with the cores of the series coils to form consequent poles. With the Ravenshaw apparatus an automatic regulator operating a variable rheostat is used to regulate the current in the keeper circuit. Experiments in this line do not seem to have been carried far enough to demonstrate practical value.

A. G. Waterhouse has patented a system in which are combined shunt and series windings of a field magnet frame having consequent poles, the shunt coils operating to shift the consequent points around the armature. I am not in possession of accurate data regarding practical operation.

Placing compound windings on the field magnet cores of a dynamo to make it self-regulating, while correct in theory, has, up to the present time, proved a failure, especially where attempts have been made to adapt it to use on arc light circuits.

Another method of regulating, the subject of a United States patent to Elihu Thomson, is termed the "dynamometric." It is based on the assumption that the power taken to drive a constant current dynamo varies directly with the e. m. f. A simple form of dynamometer mechanically connected to the commutator brushes, moves them back as the circuit resistance increases and forward as it decreases. Apparently correct in theory, there appear many difficulties to contend with in its practical application.

Having thus briefly mentioned the well known methods of regulation, in about the order of their appearance, I will say in conclusion that the best systems I have seen in operation fall far short of that accuracy and reliability that it is hoped may be reached by future inventors.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	385	400
Central Union	44	45
Michigan	72	73
Great Southern	28	30
Colorado	18	20
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27
Missouri & Kansas	69	70

The Edison Light company wants permission to place a wire across the Sault canal at a height of 180 feet, which it thinks would clear the masts of all vessels.

Forbes' Coulomb Meter.

A special meeting of the American Institute of Electrical Engineers was held in New York, October 11th, and Professor George Forbes, a distinguished scientist and electrician of England, read a paper describing his new coulomb meter. This meter was illustrated and fully described on page 178, No. 15, of the WESTERN ELECTRICIAN.

At the close of the paper Professor Forbes said: I would like to show you one or two points about the instrument. In this instrument there is one part which I have not described to you. Perhaps before I describe it I ought to let you see it working. I will put on some battery current, and we will just make it go round and see what happens. [The professor started the current.] I am starting it with a current of 11 ampères. It takes a little time to get up its full speed and a little time to lose its full speed. I have shown this lighter form of wheel work, and I am making it even lighter than it is in the instrument which is being manufactured now. This instrument has a good deal of metal work — much more than in any of the instruments which I have been using before, and the mass of metal absorbs so much heat that it went on for a considerable time after the current was broken. Now this might suit the suppliers of electricity very well, but it would not, of course, suit the consumers, and one must defer to both sides. There is another point about this instrument which I have not shown you. It is an arrangement which is attached to it for lifting up the mica vanes against a fixed stop above. I have moved the stop away, you see, at present. That lifts the mill wheel up against the stop and enables us to carry it about with safety; that is to say, I must make one reservation — there is fear of danger if it passes through the New York customs house. I brought in a lot of instruments, and after I saw a little of what the customs house people were doing, it sickened my heart so much that I let them lock the instrument up and put it in the public stores. I had worked six hours that morning like a slave, doing their bidding, and by the time it came to me I am sorry to say that many of the things were in a sad state. You will notice something hanging to that. That was an extremely delicate spiral spring, which was attached to one of these mill wheels, acting simply as an ampère meter, not acting for registering the consumption, but measuring the rate at which the current is passing through the conductor. That instrument is quite disabled, and others too. I have also some diagrams here. Here are actual examples of some of the readings of these ampère meters, and I have sometimes taken them under different conditions. I have, for example, got the instrument with the clock work in, and without the clock work, showing the amount of friction, and I may tell you this, that it looks as if the wheel work there would cause a considerable amount of friction which has to be got over. That friction is a mere nothing compared with the friction of the air which is circulating in these convection currents which are created. There are three frictions coming in: first, there is the air friction in the currents of air, which is the chief source of friction; secondly, there is the friction of the jeweled cup on the point; and, lastly, there is the friction of the wheel work, which is far less than the friction of the jeweled cup upon the point. That is what one of these diagrams shows. Another one happens to show the effect when the apparatus for fixing the mill wheel is taken out. Another one may be of some interest to you. It is this instrument when it was an experimental instrument. I varied the distance of the vanes from the conductors, and I used it at 1-16, 3-16, 5-16 and 7-16 of an inch. You might expect that the nearer it was to the conductor the greater the velocity would be of the given current. That is not so. It then creates friction by pulling the air from the surface of the wire when it is too near. Three-sixteenths of an inch was found to be the most suitable distance.

There is a peculiarity of this instrument which I believe no other meter has, and that is, I have not only my own tests of it, but I have some independent tests. I have never been able to get any independent tests of any meter in the world; but I left word before I left England, a fortnight ago, to have one of these meters finished and sent to Sir William Thomson, who was kind enough to say that he would test the instrument. The sister meter to this one was sent. This meter has an adjustment to it which no manufactured article ought to have; and no manufactured meter will have, but this being in the experimental stage, it had an adjustment which regulates the depth at which the first wheel works into the principal pinion. Now it appears that that screw had become loosened in traveling when Sir William got it, and it was not found out until after the experiments were made. But the thing is being done again. I have received the test made under the conditions of that instrument, which I will write down on the board. He applied different currents, and he got the ratio of current to speed at these different velocities. He did not try to see what was the feeblest current he could start with. He began with one ampère, and the ratio of current to speed was 66.5; with 1 5 ampères the ratio was 45.5. I will leave out the decimal place if you please. He then used two ampères, and the ratio of current to speed was 44. He then used three amperes, and the ratio was 39. He used five ampères, and the ratio was 39. He then used ten ampères, and the ratio was 42½. He then used 52 ampères, and the ratio was 42. Although I look at that as very bad indeed, I think you will agree with me that that gives you a very good result. I would have been very well satisfied with that six or eight months ago; but I confess I am not satisfied with it at present, when we are able to get it so much more accurate. However, I thought it would be worth while to give you these results of Sir William Thomson. After the instrument had been going—it was one of these instruments with a large mass of metal in it—Sir William Thomson found what I have spoken to you about, that putting the lower currents, after it had been running for a long time with 15 ampères, it was too favorable to the supplier of electricity and not favorable enough to the consumer. After that, he put it onto 10 ampères, and he got only 37 as the ratio of speed to current instead of 42½, as it was originally.

Professor Forbes then passed a current through the instrument and a recess of ten minutes was taken to enable those present to examine it. When the session was resumed, President Martin called for a discussion of the paper.

MR. VANDERWEYDE: Is it the attention to have that apparatus under that glass shade while in operation continuously? The objection would be that when the apparatus is in operation a little while the air will be heated and the ascending force would diminish and become very small at least when the air was considerably heated in the glass shade To correct that nothing would be easier than to make an opening in the top of the glass shade to let the hot air out, and keep the surrounding atmosphere more uniform. The apparatus would give an indication of less velocity if the air is made warm than if it is cooler. When the apparatus has been in operation for some time so that the air which surrounds it becomes heated, the indications would become a great deal less. I wish to do justice to Professor Forbes for the ingenuity of the apparatus, and the remark I made is only for the purpose of suggesting something which may make the apparatus more perfect.

PROFESSOR FORBES: These are very suggestive remarks that come from Mr. Vanderweyde, and of course they occurred to me during the process of experiments. There is one lesson that I have learned from this instrument, which is, that you can not calculate on what is going to happen with a convection current. [Applause.] I have been as sure as possible, over and over again, when I was making a minute change in the instrument, that I knew as well as possible what it was going to do—and it never did it. Mr. Vanderweyde suggests that when the air at the top of the shade gets heated the instrument will be slower. The only answer I can give to it is that it is not. It goes perfectly continuously, however many hours I have it at work. He suggests that a hole should be made at the top to keep it cool. Nothing in the world will ever induce me to let a hole get into that mechanism any more than I would let the works of my watch be exposed to the open air to get dust into them. But it is quite unnecessary, for it goes any number of hours at a perfectly constant rate, even when the top gets hot. It is remarkable that the first person who has spoken at this discussion, has raised the first objection which every person who has ever spoken to me about it has raised, and that is, that its indications will depend upon the external temperature; that when the external temperature is high it will go quicker. This is the only one thing, however, in which practice does agree with theory in convection currents. The theory of the thing is perfectly simple. The moving force is the difference of temperature between the conductor and the external air. It does not depend in the least on the absolute temperature of the place; it is only on the heat that is being generated in the conductor, and it is the difference of temperature created there and the external air which gives you the moving force. It is a matter of indifference whether you start with a temperature of 30 or 100. As a matter of fact, the indications in a warm atmosphere and a cold atmosphere are identical. I may forestall the question that is going to be asked immediately—whether the barometer has any effect. I may say that I have not had the instrument under an air pump to test it, but I have tested it day after day, and I have seen no perceptible variations.

MR. VANDERWEYDE: No person of any information would talk about a barometer in connection with it; but what becomes of the heat which is continually generated?

PROFESSOR FORBES: It is radiated from the surface of the glass. A great deal collects at the top. A fixed temperature is arrived at, of course, and the heat which is being created is all radiated from the surface of the glass.

MR. VANDERWEYDE: It must be confessed, however, that heat is generated continually. Now if experience proves that that does not affect the instrument, that is all right; that settles the matter; only the suggestion is very natural. Because we all know that the ascending force of air depends upon the difference of temperature between the air which is passing under the vanes and the air at the sides, and that the heat accumulated in the top must gradually descend and cause an influence I can not help believing.

PROF. FORBES: You are able to test it when you are passing a high current through it; you are able to test it by holding the hand on it.

MR VANDERWEYDE: Putting the hand on it is not a good test We have thermometers which can determine it correctly and I cannot see why a small hole in the top would do harm. The gentlemen said he would as soon expose the works of his watch to the air as to have a hole in the top of that shade. But I would like to be informed what injury a small opening in the top would be, to let out the hot air which must come up from below

FRANK L. POPE: The amount of heat which is generated by the action of the current is not very great at the most, and as it gradually collects at the top of the glass, it is probable that before the hot air has extended down far enough to effect the operation of the instrument, that the radiation has become great enough to carry away an equal amount of heat with that which is being generated and the temperature, from that on, is stationary, and that the balance is brought about before the currents of air are affected sufficiently to affect the operation of the instrument.

MR. VANDERWEYDE: But I suggest that the radiation through glass to the exterior air is very small.

MR. MAILLOUX: If it is asked what the objection would be to a small hole there, it seems to me that it is proper to ask what good it would be. When Professor Forbes has told us that the instrument works absolutely perfectly without the hole, I do not think it is necessary to consider the absence of a hole there. There are some other points which I would like to bring forward, and which perhaps

may be of greater importance than a small hole in the top of that glass shade. One point is about the friction of the apparatus. I would like to know whether the calibration of the apparatus does not depend for its constancy on the friction of the apparatus remaining constant as nearly as possible; and it also occurs to me to suggest that the friction of the apparatus may have a great deal to do with its sensitiveness as an integrating instrument. In other words, if there is very little friction, it is quite likely that the inertia would be greater and its momentum once obtained would tend to carry it over, so that if there were any abrupt changes in the current it would not so readily respond to them. So that if we were to draw a curve of variations of current it would in reality not follow that curve closely, but only partially, introducing a quantity in the result which would be the analogue of self-induction with an ordinary apparatus. Now, there is another point. In order to obtain heat from a conductor we must have a certain amount of resistance, and I would like to know whether the amount of resistance that has to be introduced in the wire (which I presume is iron from its appearance), is of material consequence,—whether it would figure at all as an element of resistance of the whole circuit, and also whether by virtue of its resistance, or of its position, it would introduce any variation, which has been called impedence, in the circuit, in consequence of self-induction or anything like that.

PROFESSOR FORBES: The first question is as to the effect of the constancy of the friction—whether the speed of the instrument depends upon the constancy of the friction of the solid parts, and the second question I had better take in connection with it, which is whether that friction of the solid moving parts renders it more sensitive. First, we have to consider whether after the lapse of months or years when the mechanical parts of the instrument are not in such good order as when it was started, whether its readings will be as accurate as they were at the beginning, and in the second place will it be as ready to start with a feeble current, with the friction of the wheel work as without it. I have already said that the most important part of the friction in that apparatus is the air friction; but that is especially so in the case of a larger current. When the currents come to the average size or greater the air friction is out of all comparison the greatest friction that we have in the instrument. At any time the friction of the steel work, incredible as it seems to most people at first sight who are not accustomed to thinking much of the subject—the friction of the wheel work is but a fraction of the friction of the jeweled cup upon the pivot. You must remember that the first wheel of the wheel work is rotated at only one-tenth the speed of the mill wheel and its weight is extremely light compared with the weight of the mill wheel, and the friction of the first wheel is therefore very slight indeed, and when you come to the second whee', its speed of rotation is diminished tenfold and its lightness is small compared with the mill wheel. I was told to expect this by a great friend of mine whose name I ought always to mention in connection with this instrument—Mr. Strow, who assisted Sir Charles Wheatstone in all of his celebrated inventions and who has assisted me in all this work, and there is no man capable of giving such assistance in the mechanical details of an instrument like this. I had intended to make a German pun, a thing I never did in my life before, and should have done so if it were not for the earnest objections of Mr. Strow, and call this a Strowmeter. [Applause.] That is the way that the friction of the apparatus comes in. It is very slight indeed compared with the air friction except with very feeble currents indeed. The result always then has been that what I call the ratio of speed to current was constant whether the friction were a little more or a little less, but that it did not start quite so easily with extra friction, and I have no doubt that if the wheel work were to get seriously out of order and we were to have very much more friction, it would not be so sensitive to a single lamp, but at higher speeds there would not be the slightest difference in the indications. For example, to show you how that works I passed around two diagrams, I think, giving you the ratio of current to speed when different currents were passing through with the clock work attached and without the clock work attached. You would notice in those that with the clock work attached it did not start with so small a current, but when the instrument was once in working order from one and a half ampères or so upwards, the two lines of ratio of speed to current were identical. As to the resistance of the instrument, I am asked whether it would afford a sensible amount compared with the resistance of the lamps. As soon as it does that we must, of course, stop using it. I have never been able to raise this wire to such a temperature that it did not indicate proportionately. I have had my wires red hot, and up to that point it was still indicating proportionately. You must simply stop using it when the resistance here compared with the lamps is something you do not like. There is another question asked which raises a subject that I ought to have spoken more fully of in my opening remarks. Mr. Mailloux has spoken about Oliver Heavyside's impedence (Mr. Mailloux had pronounced the word *im*pedence). I beg Mr. Heavyside's pardon. He has distinctly asked us not to speak of it in that way but to call it im*ped*ence. He asks me whether the effects of self-induction are perceptible in the instrument. Now there are two effects of self-induction in a coil like that; one is the effect of induction of one turn of a spiral upon another and the other is concentration of the current in all parts of the wire, not allowing the current all to pass through the whole section of the wire equally. These are the results of using an interrupted current or any variable current. Both these effects come into play. In this case I have only four turns of the spiral and their mutual influence is, of course, quite insensible. Many of you, I presume, read with interest equal to my own the delightful researches of Professor Hughes on self-induction a year and a half ago which he gave to the Society of Telegraph Engineers and Electricians in London. You will there find recognized the fact that a variable current passing through a conductor does not pass equally through the different sections and it has been more generally recognized since that time than previously that there was a greater resistance in a given wire to a variable current than to a steady current. Professor Hughes undoubtedly showed that this change of resistance is far greater in iron than in other metals. The metal I used for my conductor is iron. I confess that having these experiments in mind and having followed out Professor Hughes' experiment myself in the laboratory at a considerable distance, I did expect to find a change in the resistance when I used an alternating current and I expected that to use the same instrument for continuous alternating currents would necessitate the employment of a constant by which the readings should be multiplied in order to suit it for the alternating current. I confess with the utmost gratification that on testing it by means of the Siemens' dynamometer on the alternating current and using the same Siemens' dynamometer in testing it for the continuous current there was absolutely no difference in the readings of the instrument so long as the current remained constant whether the current were alternating or continuous and then I remembered that all Professor Hughes' experiments and all those I had made in continuation of them were done with a made and broken current in which the rapidity of change from no current to the maximum of current is terrific, and that very rapidity of change is what produces the spurious resistance, that apparent greater resistance when the broken current is being used and that when we are using an alternating current which alternates, it is true, very rapidly, but in a variable manner, in a manner whose variations are not commensurate with the rapidity of the variations in the interrupted or broken current, in that case these effects, which were so startling in Professor Hughes' experiments, donot appear sensibly. At any rate, as a matter of fact, with alternating currents and continuous currents, the instrument reads identically. No constant requires to be introduced.

MR. WHEELER: I would like to ask what is the resistance of the coil used.

PROFESSOR FORBES: Nearly a tenth of an ohm.

MR. WHEELER: And I would also like to ask if you can not overcome the effect of induction by making one coil reverse upon another.

PROFESSOR FORBES: Perfectly, but there is no effect of induction [Laughter.]

MR. D'IMFREVILLE: The instrument being so sensitive is it not desirable to take some special precaution to prevent it from registering when no current passes through it; for instance, put it in some place where it will not be subjected to a current of air, or the radiation from the sun or hot air?

PROFESSOR FORBES: No, I can not say that it is. When it is under a shade, as far as I remember, I have no recollection of ever seeing the thing moving when there was no electric current passing through it. I am pretty sure it never does move, but you must remember it requires to go round a thousand times before it registers a sixpence worth, so even if there were a few turns it would not matter a bit. The momentum of the apparatus has no effect. The momentum is extremely trifling. As soon as the momentum tries to carry it around at a different speed from that which is determined by the velocity of convection currents, these vanes are pulling every way through the air and act as a drag on it and it immediately suits itself to the velocity of the air currents. Since that question has been raised I would like to say this, that you must not expect the instrument to go jumping about at very rapid rate of changes of lamps. With a small current it takes about five minutes to settle down to its readings. With the large current it takes about a minute. That is not due in the least to any momentum in the instrument. That is due to its taking a sensible time to accumulate heat in the wire and a sensible time to get rid of the heat accumulated in the wire.

MR. SHELBOURNE, The professor said it took about five minntes to get its rate of motion in the mill wheel with a feeble current. Now in regard to the first question that was asked by Professor Vanderweyde in respect to making a hole in the top, does it not appear that the apparent inaccuracy of the instrument in registering light currents and in getting its rate may be due to the generation of heat at the commencement and that heat accumulating in the top of the instrument and heating the glass, so as to arrive at a point where there is an equation between the generation of heat by the wire and the radiation from the outside of the glass. I simply suggest this and I ask the professor whether he ever has tried in making instruments, instead of making the whole of the cover of glass, to put a dome of copper or some other conducting metal upon it, so that the air which rises and accumulates at the top may sooner reach that equation of radiation from the outside of the instrument with the generation of the heat which operates the mill wheel.

PROFESSOR FORBES: I am asked as to the inaccuracies of the instrument with a feeble current and the cause of it. I confess that as a user of the meter I have not the slightest objection to its not indicating at its full speed for the first five minutes when you are using very feeble currents. The monetary value of such a thing is imperceptible. If we were wanting to use the instrument to determine the true value of the ohm, or for any of those profound researches, it would be right to go to very great accuracy. But I do not think it necessary to go to any greater accuracy than we have at present on that point, and to make the feeble currents begin their accurate reading a little sooner. I really do not think that practically it is very important. Otherwise, I think the suggestion that was made might very likely be good—using a metal shade. Of course I have had numerous changes in shades. I have tried a shade which was nearly all metal But I found this shade before you the best one I have used up to the present time. However, I think it is quite likely that the suggestion just made might be a good one—that a metal shade would be fully as good as the other—might be better—might make it a little more sensitive perhaps. In think there may be a good deal in what you say.

MR. WETZLER: I am a little interested in knowing whether any experiments have been made to determine the best angle of those vanes and the best shape of them, and if the shape determined on there has been found to be the best.

PROF. FORBES: As to the angle, I have committed the grossest folly that a man with the experience I have had with this meter could commit—I have trusted theory. I have been positively certain that an an angle of 45 degrees must be the best. I am sorry Mr. Wetzler has drawn this confession from me, because it is really the only respect in which I have trusted to theory. As to the other points, the shape of the vanes has been the source of endless experiments. I made an enormous number of changes before I arrived at this shape, and even little details in the shape have come f om experiment, I made hundreds of vanes in the experimental stage, and I am pretty sure that if that type of mill wheel is to be used, the vanes are the right shape.

MR. RIES: Prof. Forbes mentioned at the outset that his attention was drawn to the devising of this meter by the fact that no meter existed for measuring alternating currents. Now, during the elaborate discussions we have listened to this evening, nothing was said about its application to alternating currents. Many would like to hear from Professor Forbes as to its use in that connection and if the meter is especially adapted to alternating cur ents where other meters heretofore devised are not applicable to that purpose.

PROF. FORBES: Meters in the past have been constructed by the use of, I think, only two principles of electrical action; the one being electro-chemical action, and the other electro-magnetic action. Several instruments have been devised with electro-magnetic action as their basis; but those which were sensitive enough to be practical were obliged to contain iron in their construction. I do not know of any meter which has been brought into practical form which does not depend on one or other of these two principles. In an alternat ng current, the current is of course alternately going in opposi e directions, and in any electro-chemical arrangement which may be used, whatever is done by the current when it is going in one direction is undone by the next alternation of the current. So that it seems to me hopeless to think of designing a meter upon electro-chemical action. The designing of a meter on electro-magnetic action is a far more hopeful thing; though even in continuous current meters, I believe the difficulties have not been altogether gotten over; but in using alternating currents the phenomena of self-induction come in, and not only that, but also the fact of your having iron. The intensity of the magnetization of the iron depends upon the speed of the alternations; so that as a matter of fact it has been found in every meter which has iron in its construction that the indications of the meter, even if you keep the current perfectly constant, are totally different when the speed of the engine varies; that is to say, when the number of alternations per second is changed. So that if you were testing such a meter, you would test it at one speed, and you would get at its constant if it had a constant, and then you would give it to your consumers and of course you would not run your engines at that speed; you would run at a totally different speed, which would favor your suppliers. [Laughter.] I think it is immoral to suggest such a thing as that; it lends itself to fraud. That is the objection to the electro-magnetic meter, that they give totally different indications even with the same current, when the speed of alternations is changed.

FRANK L. POPE: Like a gas meter when you change the pressure.

PROF. FORBES: Yes; like a gas meter when you change the pressure. It was thinking of these things and thinking also of other effects of the electrical current that made me conclude that the only thing which would do was heat. The reason then why this is suitable to alternating currents is that it measures the heat generated; it measures the energy which is used up; it measures a certain fraction of the energy which is being used up in the lamps, and that is what we want to measure, and it will do so whether we are using alternating currents or continuous currents.

PRESIDENT MARTIN: We have with us this evening a gentleman who has done more than anyone else to elevate the standard of electrical instruments of precision in this country. I allude to Edward Weston. [Applause.] The subject has already developed many points of great interest, and I have not the least doubt that Mr. Weston can contribute very largely to our information on these points and also touch upon others that have not yet been brought forward. Mr. Weston, we should be very happy indeed to hear from you.

MR. WESTON: I do not know that I can say very much more than has already been said in regard to the instrument by Professor Forbes. I think it is an extremely ingenious and beautiful instrument. There has been already a great deal of time and a large amount of money spent on electric meters for direct currents, and I can say with Professor Forbes that I do not think we have had any current meter of any value whatever. The electro-chemical system in use by a very prominent company here was put out with a great deal of confidence with the results to be obtained from it. I think anyone looking at the principles involved would condemn it from the start. You are to take a small fraction of the total current, and a very small fraction indeed, and pass it through an electrolytic cell, the diameter of which varies from time to time and the resistance is never fixed, and pass the bulk of the current around a resistance which is practically fixed. The change in the resistance of the metal would be but a small proportion of the change in the resistance of the electrolyte. Now, in such an instance as that, you are measuring a very small fraction of the current passing, and whatever error you have you are multiplying that error by that fraction. If you are measuring $\frac{1}{1000}$ you are multiplying your error by $\frac{1}{1000}$. Any one who has had much to do with electro-metallurgy knows that the cells are constantly changing; that to keep the deposit regular and uniform, to keep the resis ance of the solution uniform they must be constantly attended to. There is not an electroplater in the country who does not once in a while go in and stir up his baths. Such an instrument is of no real

value. We may therefore dismiss those instruments entirely from consideration, I think.

A great deal of work has already been done on magnetic instruments; that is, instruments which depend upon the magnetic attraction of the current through a wire—or the current through a wire going around an iron coil. In those instruments we have all the defects which have been referred to as being possible to exist in this instrument here, manifested a thousand times more, with numerous others that do not exist in this instrument at all. I can speak feelingly on the matter because I have given a great deal of attention to it, and have thought once or twice I had something very good and have been finally obliged to abandon it. If any one will take the record of the patent office on electric meters, he will see there has been no small amount of time and thought and money spent on that question. Practically we are in the same position we were before. We had nothing except the electro-chemical meter which, as I say, I consider entirely worthless. Instruments have been built which are approximations, but nothing in comparison with this, and if they were they would not be of as universal application as this instrument. This instrument is applicable to either alternating or direct currents with the same practical degree of accuracy, a thing very much to be desired, particularly in the present state of the art. I will refer a little to some instruments that have been built in my own laboratory, just to give you an idea of the ingenuity and skill displayed in working this instrument of Professor Forbes and how nicely it overcomes all the difficulties. [The speaker made a sketch on the blackboard.] We have here an ordinary magnet with the so-called consequent poles, which in this case are in the form of disks instead of being curved out for the insertion of an armature. These poles are brought as close together as they possibly can be. That [indicating] is an annular chamber running around the pole, into which mercury was poured. A mercury cup was also placed on the base of the instrument, in the end of which was inserted a cork afloat, to get as little weight on the pivot which entered the stem here as possible. This stem passed up right through, connected with the disk at the center, and then engaged a wheel work similar to the one that Professor Forbes has here for the purpose of registering the number of revolutions of the disk. Now if this magnet, which was wound with very fine wire, was placed and so proportioned as to be saturated with the maximum current that would be likely to flow with the difference of potential on the circuit, if the core was kept constantly saturated, then a current passing in here [illustrating] would go through the disk readily, down through the cup and out through the frame of the magnet, the magnets being placed in derived circuits so as to keep them constantly in the point of saturation. Under those circumstances, of course we should have a series of radial currents flowing out of the center to the periphery or vice versa. Such being the case, the disk would commence to rotate and record the number of revolutions on the little wheel work or registering apparatus employed with it. This instrument was the result of a great deal of hard work. It had been absolutely abandoned. I could not find anything that was really satisfactory and I came to this last of all. It stands on my laboratory table now. It has not been touched for two or three years. The instrument here, however, within certain limits was really admirable, but those limits were so narrow as entirely to prohibit its use for practical work. When the speed varied the element of friction in the mercury came into play here and very seriously changed the rate of revolution of the instrument. I do not know whether Professor Forbes has done any work on the friction between a mass of metal revolving in mercury or not.

PROFESSOR FORBES: I did a good deal of that at one time.

MR. WESTON: If you did, you will understand the difficulty. Nothing was accomplished. Now when I come to see an instrument of this kind, after the amount of work that has been put on it, it makes me ashamed to think that I spent so much time on a thing of that kind. I may say that it has already given rise to a very neat form of current instruments in which, instead of having this rotate, it was fixed, a large index here brought out from the disk, in which case it was absolutely proportional to the number of lamps in circuit. For a station ammeter I do not know of anything that equals that to-day. It shows one lamp when there are 300 or 400 or 500 on just as it shows one lamp by itself. Professor Forbes has got here the simplest instrument that I think could be built I do not see how you could improve it very much except in detail. The principles are correct, and I must congratulate him very highly indeed upon the success of the instrument.

MR. RIES: After Professor Vanderweyde's suggestion, which was the first one made this evening, about that hole in the roof, it occurred to me that perhaps another principle besides those mentioned by Professor Forbes might be utilized in the construction of a meter of this class. Professor Forbes mentioned electro-chemical action, electro-magnetic action and caloric, or heat, as the basis for a measuring instrument of this kind Now, if we could obviate the friction due to the revolution of these vanes in the air and place them in a vacuum like Cook's radiometer, and instead of utilizing the principle of heat, use that of light to give motion to the vanes, I do not know whether that would not make a very delicate apparatus. It suggests a different direction in which to work. You might perhaps take these vanes and place them in a dark cell, surround them with a strip of platinum wire or carbon filament, and use the variations in light to change the number of revolutions per second, and that could be recorded by an apparatus similar to that used by Professor Forbes. I simply offer that as a suggestion.

MR. WESTON: I did not speak of the general class of meters. There are such meters as are dependent on the action of clock work. A good deal of work has been done on those. I think Mr. Gardiner took one of the first patents out. In this case I think the clock work was to keep the gear wheels moving at uniform rates and the device for transmitting that through the recording apparatus was to enable a change to be made in the rate of recording. Of course, there has been a great variety of instruments of that class designed. Then there has been a class designed which has contemplated the quantity of gas generated by electrolysis. That can be used; but the same objection holds in that that holds in the other one, that you can not put that instrument in the direct circuit. It must be in the derived circuit, and you must then measure the gas, which induces a great many errors which have to be compensated for. Then there have been other instruments in which it has been proposed to use strips of paper running under a stylus which could be moved more or less by a magnetic current. But you can see, when you sift them all down, that there is not one which is applicable to any system of work that is now in use. This instrument appears to me to be so applicable. Some people may say that is a very delicate instrument Well, there is a great deal of very delicate work about electric lighting, and the sooner we get men who are delicate enough to handle it the better we shall be off. You can not wait for men to be educated or depend upon men entirely. You have got to run on with the art and the men must grow up with it. A few years ago there used to be no ammeters. Volt-meters used to be ridiculed. Everything was rule of thumb. People are beginning gradually to see that it is necessary to use instruments. They find it on the balance sheet. I would just as soon think about running a manufacturing establishment where electrical apparatus is made, without delicate measuring apparatus, as I would think of running a machine shop without delicate measuring apparatus It is just as foolish to try to get along with a foot rule as your standard in a shop without using standard gauges. The man who works to 1-4000, which should be the absolute limit on all first-class work, is the man you want to employ. He will save you money, because he will do your work the same way every time, and there will be no tinkering and pottering to get things together.

PRESIDENT MARTIN: It is not at all our practice to call upon gentlemen to speak, but I must say that I think I do but utter a general desire when I request Mr. Howell to favor us with a few remarks. He is working in a department which has been more than once alluded to this evening and with which he is very well conversant.

MR. HOWELL: I was very much surprised to hear what Mr. Weston said. I am surprised that he does not know that there is a temperature correction in the Edison meter. The Edison meter has been in use industrially for five years, and I say without hesitation, and I am in a position to know the opinion of the practical men who are using the Edison meter, that they think a great deal more of it to day than they did before, and the more they use it and the more they know of it the better they like it.

There is one thing about that meter of Professor Forbes which recommends it to me as the result of experience with instruments sent out for general use. There is one peculiarity about every American electrician—he has got to know what things are made out of, and if you do not show him he will find out for himself. Now that instrument shows itself. You can look at that and see what every part is, and you do not need to take it apart. I have sent out a great many instruments. The first thing a man does with them is to pull them apart and see what they are made of. There is no necessity for pulling that instrument apart; you can see all about it.

MR WESTON: In regard to the electrolytic method by the direct current, I think I am aware and I have been aware for a long time that Mr. Edison has had a temperature correcting device in circuit that will work within certain limits. I still say, and I say it without any fear of being proved incorrect, that such a meter cannot work successfully and practically within the limits that it ought to work, and I think that is the universal testimony of consumers at any rate. I suppose there will always be more or less complaint by consumers about all kinds of meters, but I think they have been pretty well founded in that case, because I think the meter is capable of doing as good work as we want a meter to do. I do not mean to say you cannot make a meter that will work.

After further discussion a hearty vote of thanks was tendered Professor Forbes, and the society adjourned.

A Legend of Cathay.

Oh, there was a Count who tried to mount
To a vast financial height,
But the clever tricks of Mitkiewicz
Are now in a sorry plight.

For he thought, in truth, that he forsooth,
Had broken the Chinese Wall
And laid on the land his grasping hand
With true adventurous gall.

And he calmly said, while his face was red
From pride at his discretion,
"I put in my thumb—just look at the plum
I have in my possession.

For you can't deny that Viceroy Li
Has, lost the land of Cathay,
And I'll show you all, both great and small,
How he gave it all away."

While thus he cried in fervent pride
At thought of his luck and skill,
Neither Salisbury nor Germany
Would take the Mitkiewicz pill.

So Viceroy Li will surely try
To regain his great franchises,
While 'tis the fate of the syndicate
To part with its Chinese prizes.

Thus Mitkiewicz is in a fix,
And filled with natural ire,
And the Viceroy's name, perchance he'll claim,
Was never Li, but Liar.

—*New York World.*

CORRESPONDENCE.

Eastern Electrical Comment.

NEW YORK, Oct. 15.—The progress of the underground electrical work in the city has not brought about a state of complete happiness. It is barely possible that Contractor Crimmins may enjoy the existing condition of affairs, but even he has felt called upon to address a letter to President Hess, of the Board of Electrical Control, in which he replies to the criticisms of the press upon his obstructing various streets. He has made a careful survey of the work in progress and finds a total length of 4,486 feet of pavement in a disturbed condition, which includes all of the subway work proper and the Edison system. This covers 19 different openings, the shortest of which was five and the longest 540 feet. There have been laid down by the conduit company a total length of 155 miles of 2½ inch ducts, which, it is expected, will be increased to 200 before the work is stopped by cold weather. The excavation along Park row approaching the East river bridge is progressing slowly on account of the numerous tracks in that vicinity. The dirt, instead of being piled up in the street, is carried out of the way in baskets. Now that this conduit is nearly completed, ground is being broken on Broadway, extending south from Cortlandt street, for a continuation of the structure toward the Battery

The New York District Railway company is working persistently to obtain the consent of the owners of one-half the valuation of property along its line, which is necessary before operations can commence. A sufficient number of signatures have been obtained in the Twenty-third street district, and nearly enough in the Fourteenth street section, but farther down town more difficulty is experienced. The managers of the company are confident, however, that all these legal restrictions will be complied with so that work can begin this fall. Colonel Hazard is the leading spirit of the enterprise and no thought is given to any other than the electric motor for the movement of trains.

The absorption of the Baltimore & Ohio by the Western Union Telegraph company, after monopolizing the columns of the daily press for a week or more, has subsided to such an extent that an evening paper apparently ends up the matter by a dispatch from Baltimore to the effect that Robert Garrett is confined to his house from the effects of a splinter which ran into his big toe while he was walking about his room barefooted.

With the advent of electric lighting there was an occasional croaker, who thought that it would injure the match business. According to the statements of the match peddlers, however, that industry is improving, and the reason for it is asserted to be that smokers who required a light frequently resorted to the nearest gas jet. Now that electric lights are so common they are liable to go without their smoke occasionally unless they carry matches with them.

The increased cost of coal in Vermont, caused by the inter-state commerce law, has led many manufacturers to experimenting with other kinds of fuel. One establishment at Bellows Falls is mixing saw-dust with soft coal, while another is using crude petroleum with very good results. The elevated railroad in this city has also fitted up a locomotive for the use of petroleum.

The electric light war in Elizabeth, N. J., has not yet ended. An attempt is being made to bring about an amalgamation between the existing arc light company and the Westinghouse incandescent. There is the usual difference of opinion between the interested parties as to the price, but there will no doubt be a consolidation of the companies at an early date.

In Morristown, the city authorities have opened war on the electric lighting company by ordering the removal of all poles and wires from streets where no permission has been granted for their erection. The difficulty will doubtless be removed by the exercise of a little diplomacy.

George Westinghouse, of Pittsburgh, has recently bought two farms containing about 65 acres in Lenox, Mass., which has attained considerable celebrity as a fashionable summer resort, and is certainly a most attractive and salubrious locality. Already there is talk of

lighting the village by the converter system, utilizing the water power at Curtisville, a distance of about four miles.

The appearance of Professor George Forbes before the American Institute of Electrical Engineers, October 11th, led to a decidedly crowded house, and a more interesting paper, discussion and exhibition has rarely been given before an electrical audience in this country. The coulomb meter is a model of ingenious simplicity, and nothing more pleasing to its distinguished inventor could have been provided for his entertainment than the generous admission of Edward Weston, who so heartily admitted the perfection of the apparatus, at the same time demonstrating upon the blackboard his own futile attempts to provide for the measurement of the consumption of electric currents. P.

From the Pacific Slope.

San Francisco, Oct. 10.—At Stockton, a franchise has been granted for an electric street railway from Lodi to Woodbridge.

At San Jose the six months allowed the electric motor railway company in which to complete the work will expire next Wednesday, and it looks as though the franchise would be forfeited. Two other companies stand ready to seize the franchise if it is forfeited.

Berkley is to have an electric railway. A company has been formed, and it has asked for a franchise, the road to be completed in less than nine months after receiving it.

Four hundred and thirty feet was bored in the two headings of the Cascade tunnel through the mountain last month, leaving about 3,500 feet to finish. This is said to be the best record ever made in boring, as both ends carried a wall plate the entire distance. This record is largely due to the use of electric lights.

The Santa Rosa Gas company, the present owners of the Thomson-Houston electric light plant there, purchased the electric light plant of the Pacific Coast Construction company, and thus secured a monopoly of the lighting business. On the 3d the advanced rates of sixty-six and two-thirds per cent. were published and met with much disapproval. A number of lights were cut off, the consumers claiming they could not stand the advance.

The messenger boys in the service of the Western Union and San Francisco district telegraph companies have subscribed $100 for the relief of the parents of John Garrigan, a boy who was killed by falling from the roof of the Windsor hotel on the 6th inst.

At Nevada the Nevada County Land & Improvement association have petitioned the board of supervisors for a franchise to construct an electric railway between Nevada City and Grass Valley, a distance of four miles. Water power is obtained there at 500 feet head and in large quantity.

At Oakland the electric railroad is said to be a success. S.

New York Notes.

New York, Oct. 15.—The Baltimore & Ohio Telegraph sale continues to be the talk of the day. After Mr. Garrett's arrival from Europe it was reported that he had said that the sale was off and that the Western Union could not have the Baltimore & Ohio Telegraph. This made a sensation for a day or two, but it was soon evident that he could not prevent the sale and that the Western Union was secure in the possession of its purchase. On Wednesday, Mr. Garrett's resignation as president was accepted by the directors of the Baltimore & Ohio railroad, and on the same day they ratified the sale of the telegraph company. It is said that Mr. Garrett tried his best to keep the company out of the hands of Gould. He held it at from $10,000,000 to $15,000,000, and wanted it purchased by outside parties and continued as a competing organization. The Baltimore & Ohio officials had full authority to act, and they knew that the telegraph could bring no such sum. While in Europe, Garrett heard of the offer of the Western Union, and at once started home, but while he was on the water the papers were signed.

The Postal Telegraph company has procured an injunction restraining Sheriff Grant from collecting the assessment, about $2,000, levied upon it by the subway commission as its share of the expense of laying the telegraph wires under ground. The telegraph company claims that the subway law is unconstitutional.

Two rival improvements of the phonograph are soon to be put upon the market. One of these is the graphophone, owned by the American Graphophone company, of Washington, which is now having a number of its instruments manufactured in this city. This company was organized in Washington six months ago and is working under the patents of Alexander G. Bell and Sumner Taintor. The other instrument is being made by the Edison company in Bloomfield. This one is smaller than the ordinary typewriter and will be sold at retail for about $100. The company claims that the machine reproduces the voice so clearly and accurately that the words cannot be misunderstood. The owner of the machine merely has to talk into it as he would a telephone, and when he is through his typewriter can ungrind his remarks and materialize them on paper.

The Edison Electric Illuminating company has filed specifications for a $115,000 four-story building on West Thirty-ninth street, for the manufacture of its light.

The General Time convention composed of railroad managers and superintendents was held in this city on Wednesday. The session was principally devoted to the discussion of the present system of signals and the subject of moving trains by telegraphic orders. Commander Brown, U. S. N., of the Naval Observatory at Washington, addressed the convention on the topic of transmitting time from the National observatory automatically.

A flight of migratory birds struck the statue of liberty Tuesday night, attracted by the electric lights, and of those killed 109 representing twenty-one species have been sent to the United States national museum at Washington. S.

Detroit's Budget.

Detroit, Oct. 15.—The gas companies are now to take a hand in the public lighting matter. They propose to light the city with gas until their electric light plant, which they will put in, if awarded a suitable contract, is ready. This plant, it is stated, would be completed within a year, when gas would be superseded by electricity. The city's ordinance relative to underground wires, would be complied with. The next meeting of the aldermen will be lively. There are members in the board who have no confidence in the attitude which the gas companies have assumed. Some aldermen are hinting that they will not give the gas companies a chance to come in at this late date unless they give the city a bond that they will bid to light with electricity and do it cheaper than the Brush company has yet offered.

The Michigan Cushman Telephone company has now under way a couple of lines and has a few offices in commission, the agents of which have been duly proceeded against by the American Bell company as follows: Philo L. Daniels, Lansing; John M. Potter, Pine Lake; Joshua G. Marsh and Dwight Marsh, Shaftsburg; Alton O. McEwen, Perry; Henry P. Halsted, Morrice; Henry M. Billings, Henry A. Hart and William H. Hart, of Bancroft. A bill of complaint has also been filed against the Michigan Cushman Telephone company *et al.* This bill is directed against the incorporators of the company, as follows: Benjamin W. Warren, Daniel P. Sagendorph, Charlotte; John Evans, Bellevue; Thomas H. Bottomley, Capac; Walter S. Powers, of Northville. The St. Clair and Sanilac Telephone companys' agents at recently established offices —also users of the Cushman instruments—come in as follows: William Potter, Bad Axe; Charles E. Thompson, Bad Axe; Frank W. Hubbard *et al.*, Aurora City.

The Western Union company is making extensive additions, involving an expenditure of $25,000, to its upper peninsula plant, the rapid growth of that portion of the state having necessitated better facilities than those heretofore provided by private lines to out-of-the-way points. A new cable is to be laid across the Straits of Mackinac which, with the recently acquired lines from Point St. Ignace to Sault Ste Marie, will bring the principal towns into direct communication with Detroit.

Articles of association of the Electrical Accumulator and Lighting company were filed to day. The capital stock is $100,000 paid in. The stockholders and officers are: James McMillan, president; Wm. A. Jackson, vice-president; W. K. Anderson, treasurer; W. C. McMillan, secretary; Geo. E. Fisher, general manager; Frank E. Snow, Emery Wendell, Ashley Pond, J. B. Dyar, Hugh McMillan and Frank E. Fisher.

The Edison Electric Light and Power company was organized at St. Louis, Mich., on the 10th inst. Capital stock $8,000; Col. John A. Elwell, president. C.

Cincinnati Chat.

Cincinnati, Oct. 15.—Saturday morning fire was discovered in the rooms of the Wrightson Printing Co. at 11 and 13 West Fourth street. The fourth floor was occupied by Chas. Hill, W. L. Silvey and J. H. Elfering, electrical experts and model makers. W. L. Silvey had a number of motors and locomotive lamps for electric lighting, and some valuable papers destroyed that makes it a serious loss to him. While the shop of J. H. Elfering was not damaged by fire his entire stock of tools was badly injured by heat and water. He had some very valuable work in hand. As his model making is all of the finest kind of electrical work it will be a very heavy loss.

There is a good prospect of Cincinnati having an electric club. The right men are at the head of it and it is bound to be a success.

The United Lines Telegraph company have been circulating hand bills for the past few days calling the attention of the people to the fact that they are "the only opposition" since the consumation of the B. & O. and Western Union deal, and not to patronize "monopoly and high prices."

The transfer of the B. & O. to the Western Union was made here on Saturday at midnight. There was a feeling among a great many of the B. & O. operators that they would be discharged at once, but an official notice from B. F. Lloyd, superintendent of the B. & O., posted Saturday, gave them the assurance that nearly all would be retained. His message was very cheering to the employes as Mr. Lloyd is well liked by all, and in closing he wished "all, who had worked together under the 'maltese cross,' success under the new management."

The Queen City Electric Co., located at the corner of John and Water streets, have all they can do and are behind with their orders. The company is composed of some of Cincinnati's most substantial business men. A. R. Foote is manager, and L. W. Davis, superintendent and electrician. They have ten plants now in use in this city and quite a number outside of the city. T. J. Ryan gives his time to this part of the work and for the short time the goods have been on the market with the strong and older competition it speaks well for his ability as a salesman.

We have now in operation four companies that do exclusive dynamo and motor work. M.

In the North-West.

St. Paul, Minn, Oct. 16.—The mercurial fire alarm business is gradually growing in this section and saving valuable property every year. Since its introduction in St. Paul three years ago, it has given alarm for over $1,000,000 worth of property endangered. In no case has it been a failure. The merchants are beginning to understand its value and considering its adoption generally. A short time ago what is said to be the largest grain elevator in the world, at West Superior, Wis., was fitted with the system, and it is expected that another elevator nearly as large, in the same place, will be fitted this fall. It proves very valuable for grain elevators.

The Edison people are doing a good business in the city through their lively agent, Mr. Woodward, who is ever on the alert. During the president's visit they placed an arch across Wabasha street forming these words, "Hail to the Chief," composed of colored incandescent lamps, and also a large anchor at the corner Third and Minnesota streets.

The Gas company also made quite an illumination for the Globe people, placing twenty-five arc lamps on the outside of their ten-story build-

ing, including four on top of the tower, making the most brilliant display of arc lights ever in St. Paul.

Private house electric work in St. Paul is, as yet, in its infancy. A few of the best houses have a good supply of electric work, but not as a general thing.

The Edison company were the successful bidders for the new court house contract. The building will be lighted throughout by their system.

John Young, of the Western Electric company, of Chicago, was in town this week, and made short calls on friends in both cities. G.

Meridian, Miss. Mention.

MERIDIAN, Miss. Oct. 10.— Messrs. Elmire & Schular have fitted up the St. Charles hotel at Meridian, in the latest style. They have electric lights throughout the house and telephone connection with the city.

Mobile, Ala. now has connection by telephone with Whistler, Ala. The line is owned and operated by the M. & O.R. R. Co.

Telegraph operators, and telephone men in this section of the country are very much excited over an advertisement appearing in the *Times-Democrat* this morning, in which a syndicate offers $200 per month and free passage to China, for their services. This salary is about three times as much as they are now receiving. There is no doubt but what every man that knows anything about the telegraph or telephone will make application for position.

Oscar Lillybeck has had his drug store fitted up with a burglar alarm and electric bells.

Sam Crawford, an old time operator, has returned to his former home, State Line, Miss. J.

Indianapolis Items.

INDIANAPOLIS, Oct. 14.—Some time ago suit was brought by State-auditor Carr in the circuit court, against the Western Union Telegraph company for penalty amounting to $1,900 for failure to make necessary reports of their receipts from business in the state. A law of the state provides that all sleeping car, express, or telegraph companies shall annually file with the auditor of state a statement of their receipts within the state, on which they shall pay a tax of one dollar on each $100, and, failing to do this, they shall forfeit $100 a day for such failure. The telegraph company claimed the law unconstitutional, basing their claim on a decision given in a similar case some time ago. The case has been compromised by the company agreeing to pay $5,927, covering the period from 1880 to the present time.

Superintendent Cherry, of the fire alarm telegraph, has rebuilt a large portion of his lines this summer and fall, besides thoroughly overhauling all his apparatus, getting things in shape for coming winter. M.

Personal Paragraphs.

C. J. Van Depoele electrician of the Van Depoele Electric Manufacturing company of Chicago left last Saturday for a trip including Scranton, Pa., Binghamton, N. Y., Ansonia, Conn., Jamaica, N. Y., and other places. He was in attendance, at the convention of street railway men in Philadelphia this week.

C. F. Annett, general manager of the Rocky Mountain Bell Telephone company, Salt Lake City, was in town last week. He left for the east Saturday night, and will take in New York and Boston on his trip.

THE ELECTRIC LIGHT.

The R. J. Dee Electric Light Illuminating company of Houghton, Mich., organized last April, was merged, October 1st, into the Peninsula Electric Light & Power company, with Jay A. Hubbell, president, James B. Sturgis, secretary and treasurer, and James R. Dee, general manager. The capital stock is $50,000, divided into $2,000 shares of a par value of $25 each. The company is operating one 45 and three 30 arc lights of the Thomson-Houston system. The power consists of one 10"x12" Porter Manfg. Co. engine, and one 10"x12" Ball engine. The company also operates 50 to 60 series incandescent lamps from 16 to 65 candle power from their arc light circuits.

THE ELECTRIC MOTOR.

It is said that an electric railway around Mackinac island to be built next year is being considered.

The Lindell Street Railway company of St. Louis, Mo., have not yet concluded their tests of electric motors.

Woodland, Cal., will probably have an electric railway. The parties interested have examined the motor on trial in Piedmont and are pleased with its operation.

THE TELEGRAPH.

The closing of many Baltimore & Ohio telegraph offices at competitive points with the Western Union is the order of the day.

A division of the order of Railway Telegraphers will soon be organized at Newton, Kan.

All messenger boys under sixteen years of age employed by the former Baltimore & Ohio Telegraph company in Chicago have been peremptorily dismissed.

THE TELEPHONE.

Suit was instituted in the United States court at Little Rock, Ark., October 14th, by the Bell Telephone company against the Southern company. The petition recites that the Edison patent, which the plaintiffs own, has been infringed by defendants' machines, and a perpetual injunction is asked. The case has been set for trial Nov. 17th.

NEW ENTERPRISES.

The Magnolia house, W. W. Palmer owner, at St. Augustine, Fla., is to be lighted by electricity.

The Mason City, Iowa, fire department is in need of a fire alarm bell, hose cart, hook and ladder truck.

The Inter-state Building company of Kansas City, Mo., will put up five residences of three stories each, estimated cost $117,500. Each will be provided with electric bells.

John Lewers of Kansas City, Mo., will build a two-story residence to cost $5,200 and will put in electric bells.

A new city hall is to be built at Tuscola, Ill., in the near future.

BUSINESS MENTION.

C. C. Warren, manager of the western department of the United States Electric Lighting Co., 216 La Salle St., Chicago, closed contracts for 44 plants aggregating thirteen-thousand nine hundred and seventy-five incandescent lights during the months of August, September and the first half of October. He also closed many large arc light contracts. The magnitude of this business is said to be unequaled in the history of electric lighting. It is understood that the eastern office of the company has also been crowded with orders.

The Hill Clutch works of Cleveland, O., have opened a general eastern office under the management of Messrs. Tewksbury & Wonham in Room 510, Metropolitan Telephone building, 18 Cortlandt street, New York.

C. Kammeyer, representing the Archer Electric Manufacturing company, of Witchita, Kan., has closed a contract with the Lyons, Kan., Electric Light & Power company for a plant of 30 arc lights of the Fort Wayne Jenney system and a steam plant, including engine, boiler, heater, pump, injector and other fixtures.

In Anthony, Kan., an electric light company has been organized by the Archer Electric Manufacturing company, of Wichita, Kan. A Fort Wayne Jenney plant of 25 arc lights and 300 incandescent lights will be put in.

The Jenney Electric company, of Indianapolis, Ind., have recently added a room 50x140 feet to their factory. During September they booked orders for Berkley, Cal., Holton, Kan., Clarksville, Tenn., Udell Ladder Works, Indianapolis, Ind., Hall Safe & Lock company, Cincinnati, O.; St. Joe, Mo., and Lapeer, Mich, in addition to a number of minor orders. From the time the company first engaged in business, not a dynamo has been built without an order from a purchaser behind it.

The Geneva Non-Magnetic Watch company of 177-179 Broadway, New York, represented by A. Conkling, has an exhibit in room 40 at the Palmer house prepared more especially for the convention of the International Brotherhood of Locomotive Engineers, which began in Chicago on the 20th inst. There is a large display of watches, and to prove their perfect exemption from magnetism a small dynamo has been placed in the room by the United States Electric Lighting company on which watches are placed in fearless disregard of any evil consequences. Chicago electricians will doubtless seize the opportunity to investigate the merits of the watch and satisfy themselves by personal examination of its undoubted freedom from that prevalent influence having its source in moving electrical machinery and from which there is no protection for time-pieces not fortified against it.

Electrical Patents.

Issued Oct. 11, 1887.

371,161. Insulating Clamp for Electric Conductors. Thomas E. Adams, Cleveland, Ohio.

371,189. Voltaic Inner Sole. George A. Fullerton, Boston, Mass.

371,199. Electric Spinning or Twisting Machine. Alonzo S. Kimball and George L. Brownell, Worcester, Mass.
A series of spindles are actuated by a series of electro-motors, current being distributed to said motors by a commutator rotated independently of the mechanical resistance of the revolving spindles. The magnet of the motor is placed above the plane of the revolving armature attached to the spindle, so as to raise the spindle and reduce its friction upon the spindle bearings.

371,202. Electric wire Conduit. John Lynch, Washington, D.C.

371,241. Telephone System and Apparatus. Granville T. Woods, Cincinnati, Ohio.

371,244. Primary Battery. Mark Bailey and John Warner, London, England.
The battery is of the Leclanchè type. The porous cup contains a paste of plumbago mixed with a mixture of nitric acid and sulphuric acid, about half a pound of each acid being used with each pound of plumbago

371,248. Process of Coating Iron with Tin or its Alloys or other Metals. Edward J. Braddock, Medford, Mass.
The iron is coated with iron by electro-deposition. The iron coated iron is then immersed in molten zinc, lead or tin.

371,253. Electric Locomotion. Leo Daft, Plainfield, N. J.
The driving shaft supports one member of the driving gear, while an electro-motor, pivoted to spring bearings at one side of the driving shaft, carries the other member of the gear directly over the driving shaft.

371,256. Apparatus for Forming Sheet Metal by Electro-Deposition. Elisha Emerson, Providence, R. I.

371,260. Telephone Switch. William M. Goodridge, Highland Park, Ill.
The contact springs are mounted on a block of rubber and bear on opposite sides of the short arm of the telephone support, rubber preventing electric contact with the arm. A metallic piece on top of the rubber block and under the rubber heel of the short arm serves as the line terminal. No special retractile spring is required since the spr ngs are adjusted so that the weight of the telephone will overcome the difference between the resistance of the bell contact spring on the one side and the resistance of the telephone contact spring and the local contact spring on the opposite side.

371,331. Apparatus for the Transmission of Electrical Energy. Gustav Korumüller, Ghent, Belguim.

371,336. Means for Supporting Overhead Conductors. George W. Mansfield, Cleveland, Ohio.

371,356. Electro-Therapeutic Belt. William L. L. Pierce and William J. Pierce, San Francisco, Cal.

371,358. Secondary Battery. Anthony Reckenzaun, London, County of Essex, England. The plate or electrode is formed by forcing the active material into a body of molten lead by pressure and then allowing the mass to cool. The active material is disposed in the shape of cylindrical particles parallel to the edges of the retaining plates and equally exposed on both sides thereof.

371,406. Plastic Composition for Insulating Electric Wires, etc. Wesley W. Barnes, New York, N. Y.
Pulverized mineral coal and crude sulphur, five parts of coal dust to one part of sulphur dust are mixed together and fused by heat.

371,436. Method of, and Apparatus for Starting Electric Motors. Leo Daft, Plainfield, N. J.

371,443. Reversing Mechanism for Electric Motors. Frank E. Fisher, Detroit, Mich.

371,445. Electric Signaling Apparatus. William Glasgow and Samuel S. Stevens, Chicago, Ill.

371,521. Galvanic Ring. Horace N. Rowell, Boston, Mass.

371,524. Induction Coil. Elias Smith, Peoria, Ill. A dental appliance. The benumbing effect is caused by a current passing through the forceps to the tooth.

371,531. Method of Operating with Electrical Conductors. John E. Watson, Louisville, Ky.

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BUILDERS OF
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BOILERS, ETC.
Complete Power Plants Furnished and Erected.
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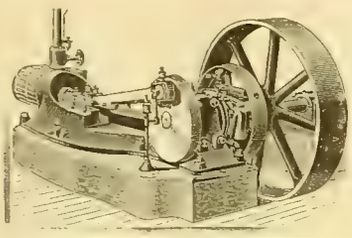

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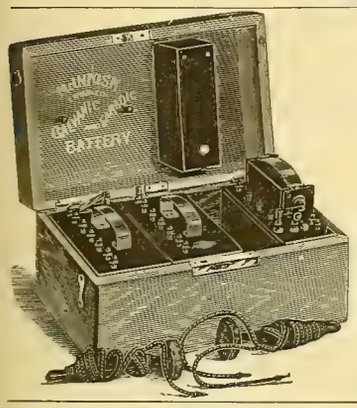

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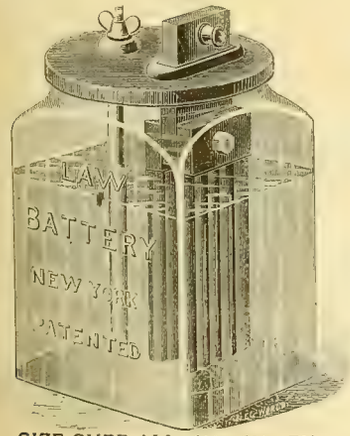
THE IMPROVED "LAW PRISM" BATTERY



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With the exception of glass broken by carelessness, and the zinc and sal-ammoniac consumed in the production of current, **all parts of this Battery are Guaranteed** to be **Everlasting.** Perfectly **uniform** and **reliable** in action, of **faultless construction** and **beautiful appearance.**

PERPETUAL NEGATIVE ELEMENTS!!!

These consisting of specially prepared prisms of Carbon are fine depolarizers, performing this function indefinitely, **do not require renewal,** as is the case where chemical depolarizers are employed, thus a **great economy** is effected. These cells are so constructed as to prevent evaporation of the solution, and crawling out of the salts. Thousands of these cells now employed for **Telephone Transmitters, Gas Lighting, Annunciators, Burglar Alarms** and other **Automatic Devices** are giving **Perfect Satisfaction.**

The many Physicians now using the "**Improved Law**" as an office battery, are unanimous in their expressions as to its perfection and adaptability for electrolysis and general galvanization, requiring no renewal nor attention in from two to five years, the latter depending only on the amount of use.

Note:—This battery is not suitable for Galvano Cautery nor Incandescent Light purposes.

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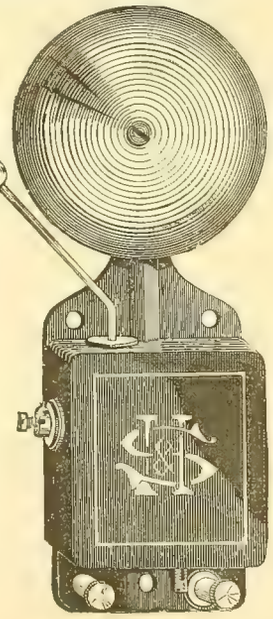

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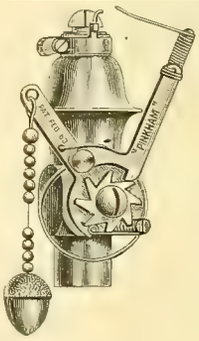

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The Lift-Over Electrode is a very important feature no other Pendant has.

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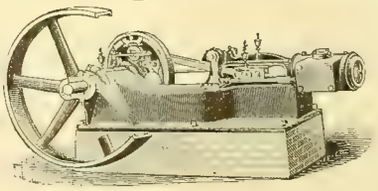

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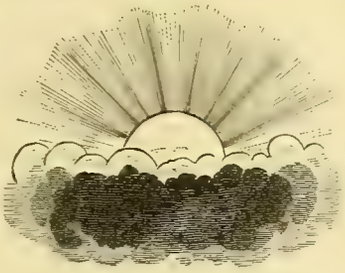

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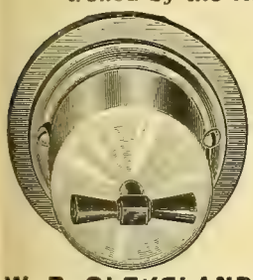

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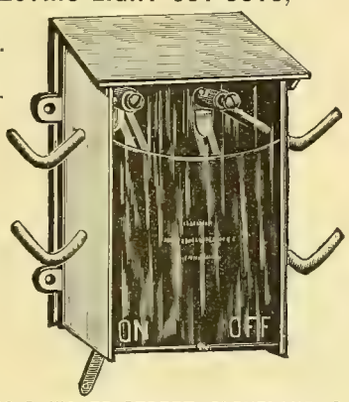

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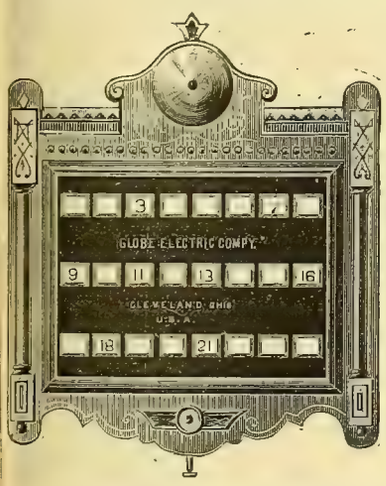

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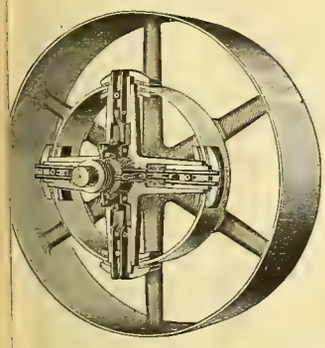

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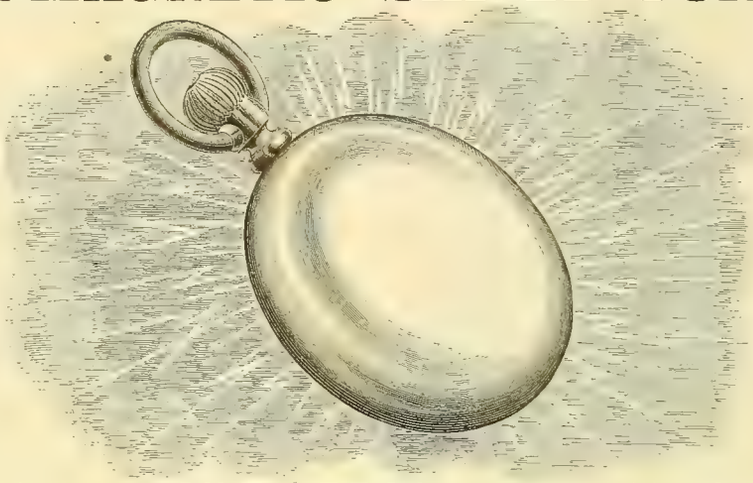

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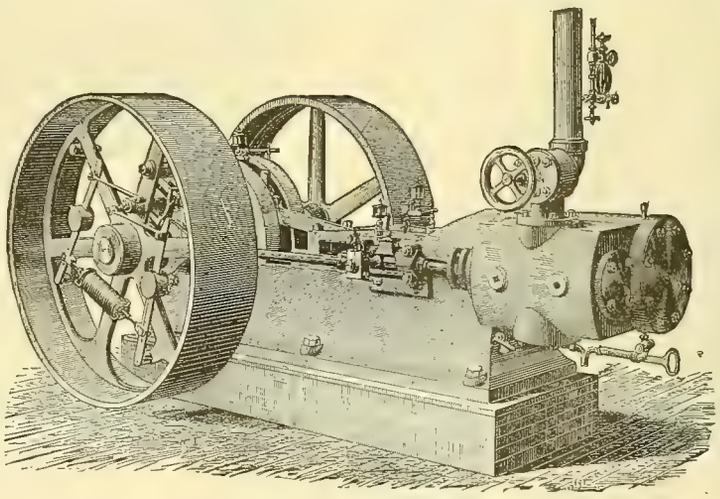

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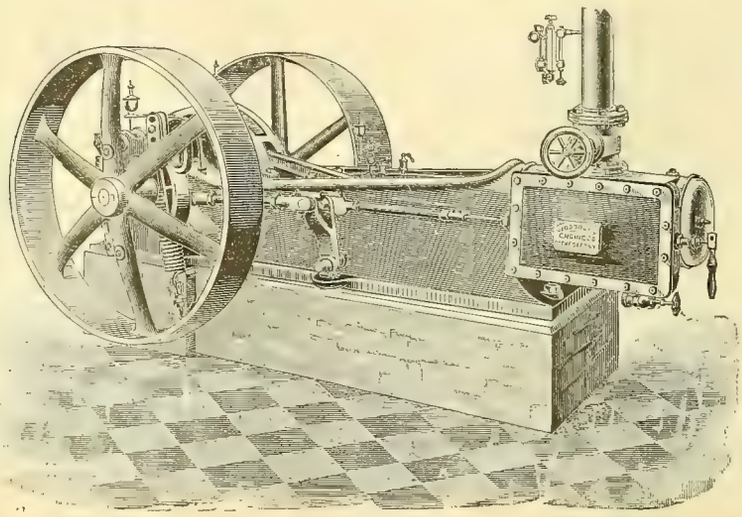

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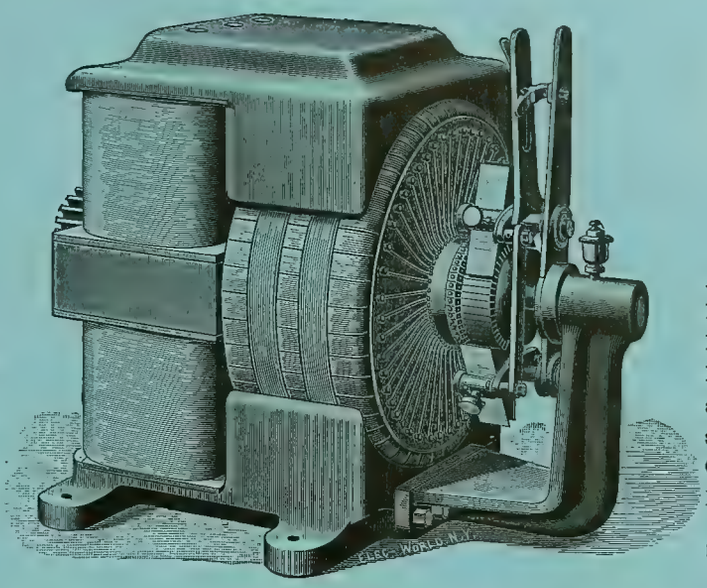

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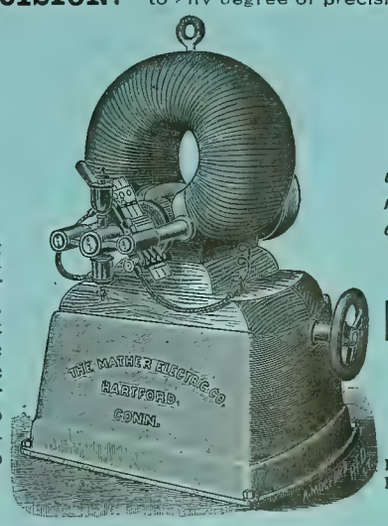

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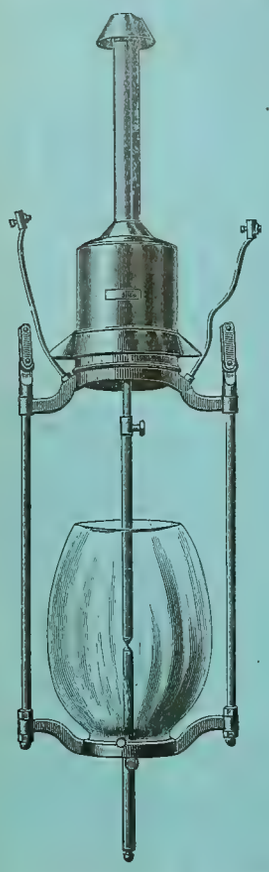

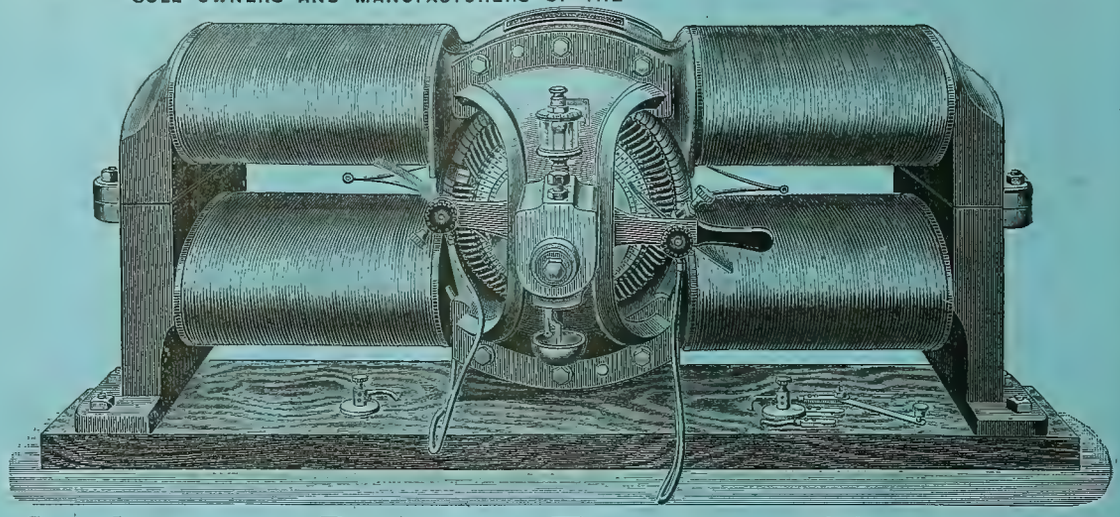

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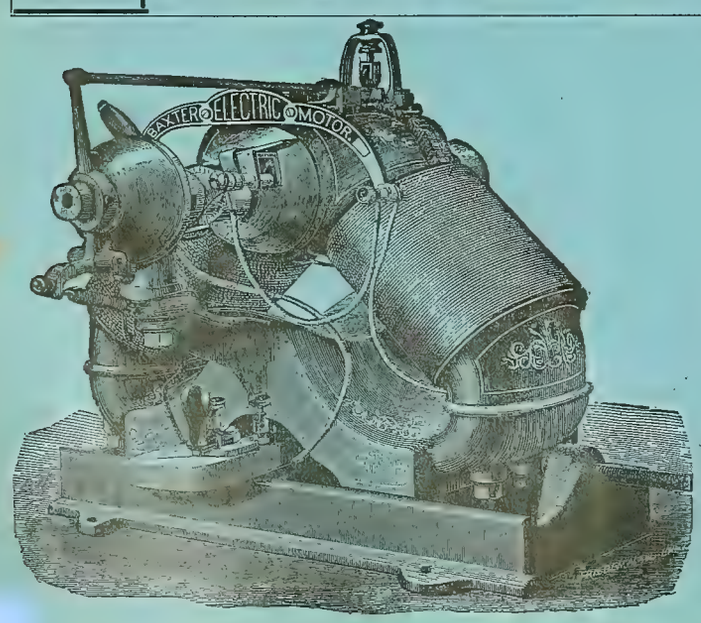

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Vol. I. CHICAGO, OCTOBER 29, 1887. No. 18.

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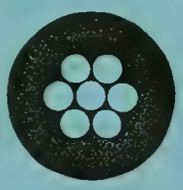

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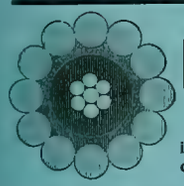

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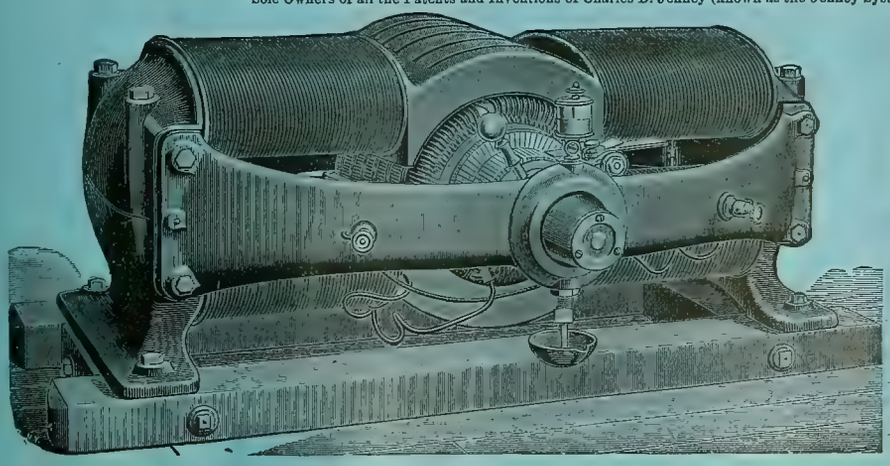

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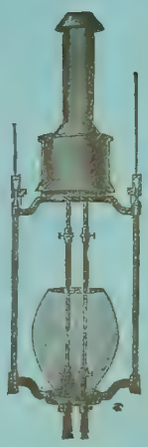

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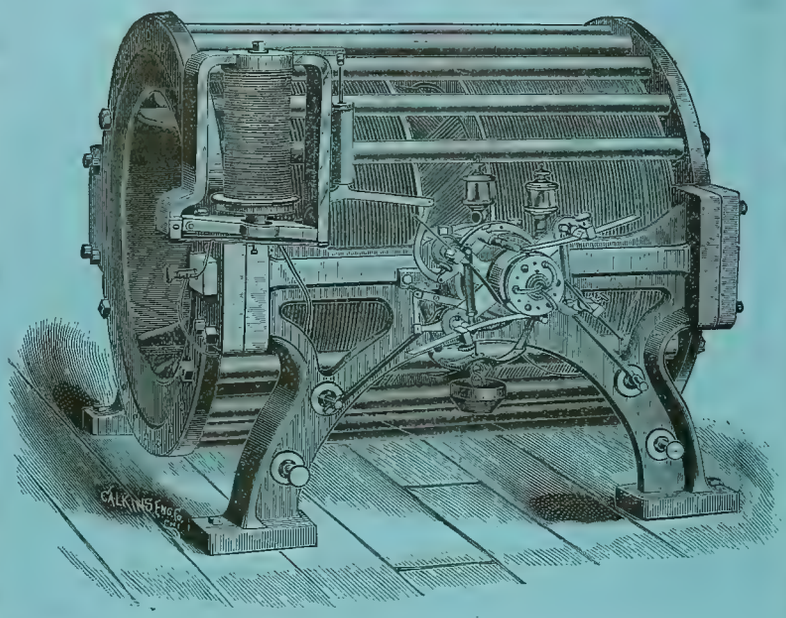
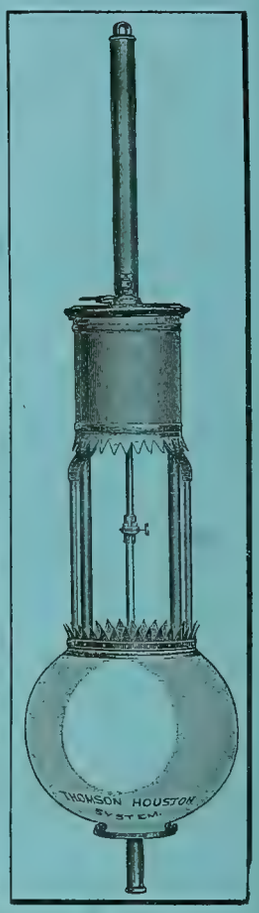


The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.



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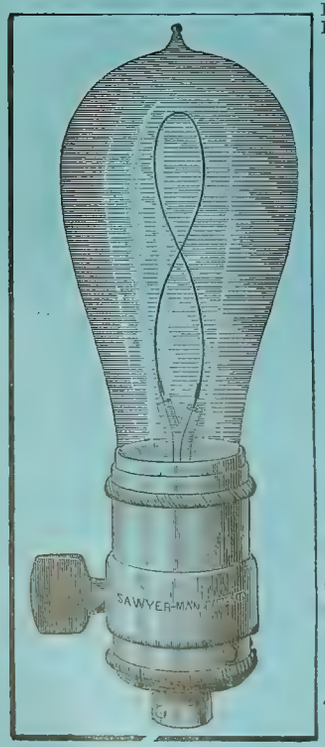

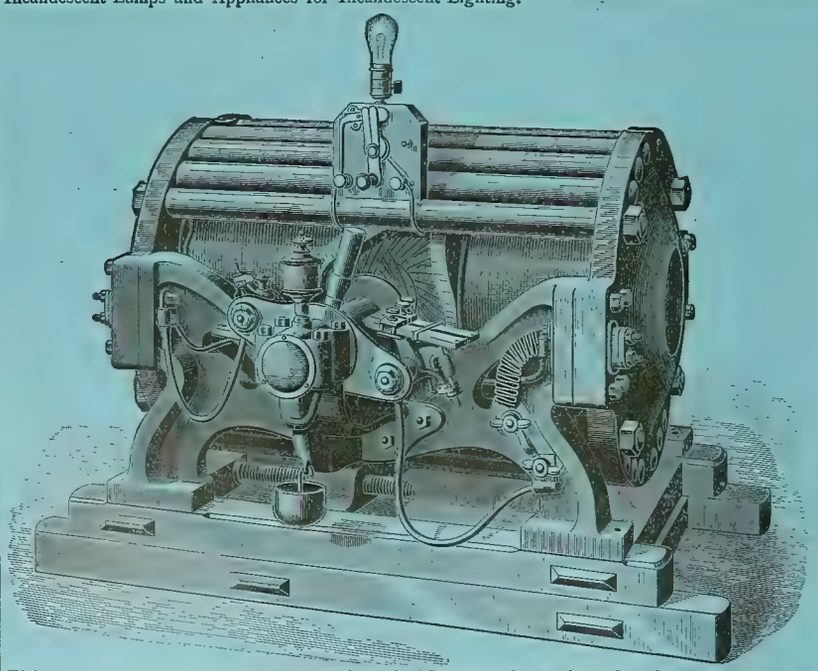

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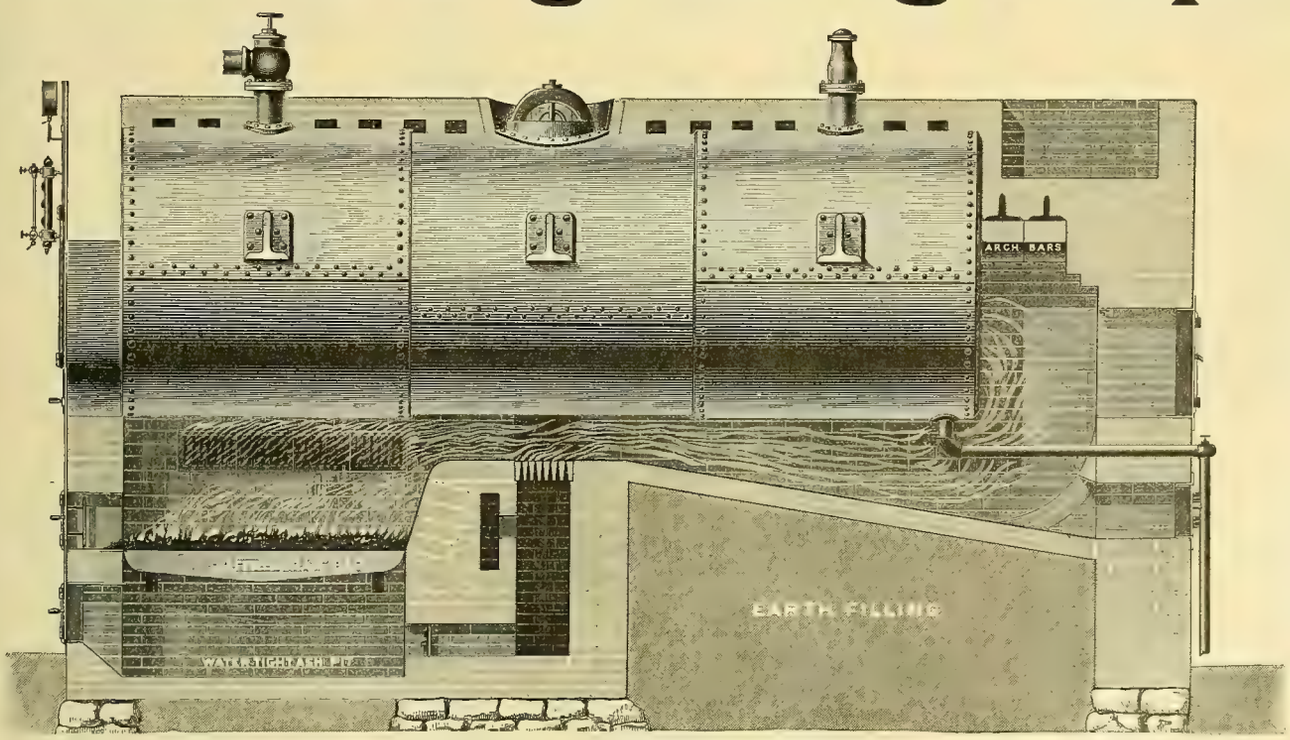

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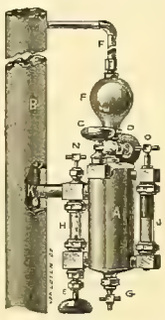
There will be a meeting of the CHICAGO ELECTRIC CLUB, Monday evening, November 7, at 8 o'clock, at the rooms of the Club, 122-124 Clark Street.



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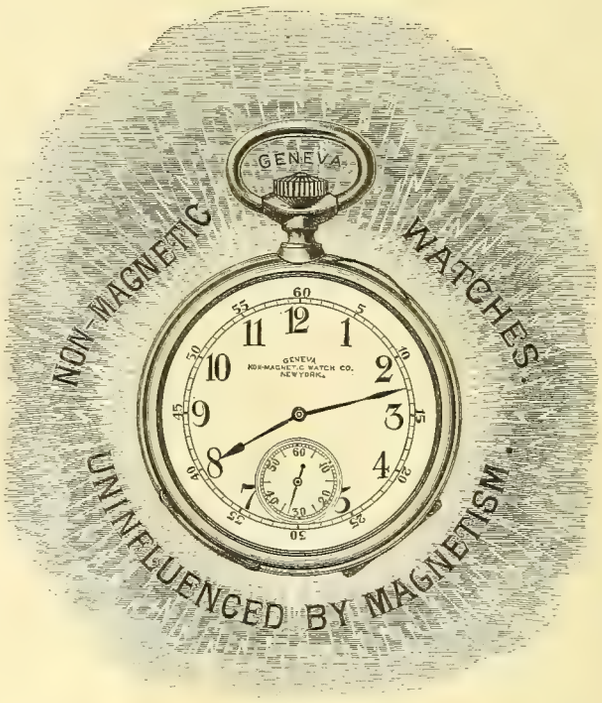

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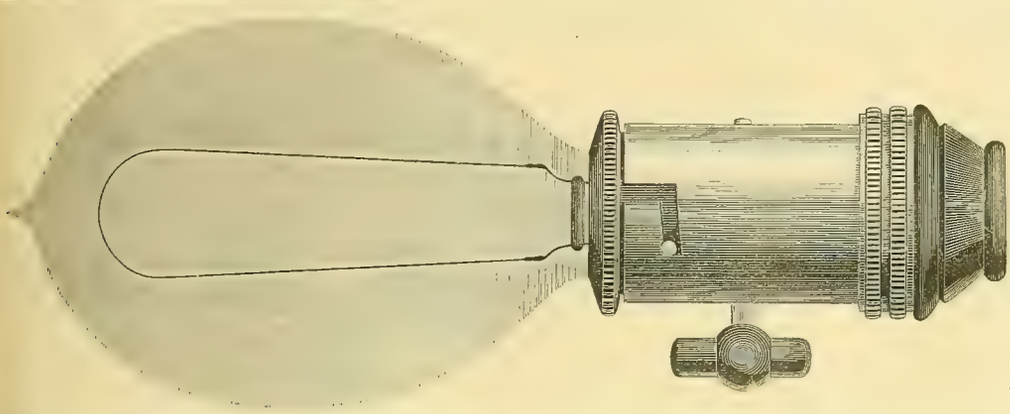

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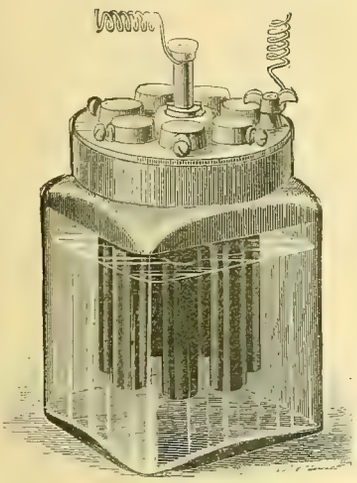

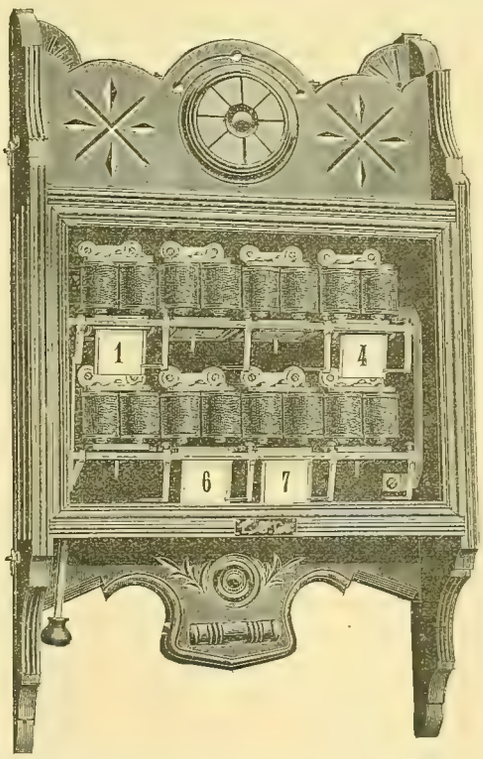

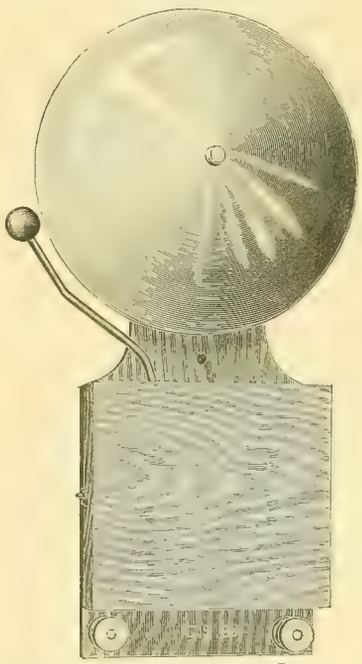

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DISQUE LeCLANCHE BATTERY.

We make the best Disque LeClanche Battery in the market, and guarantee it.

We will replace, without charge, any porous cup which fails to give satisfactory service within nine months from the date of its manufacture, if the cup be returned to us sound and whole.

WESTERN ELECTRIC COMPANY,

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MANUFACTURERS OF **Automatic Electric Motors** (MATHER PATENTS.)

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THE MATHER DYNAMO ELECTRIC MACHINE,

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These Machines cannot reverse, use no water, do not spark, and are noiseless. Satisfaction Guaranteed.

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Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading as follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT,
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously installed by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 300 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C C Warren Esq
Dear Sir. I have written the answers opposite your questions above as far as our records, and trust they may be of benefit to you. I have been so thoroughly satisfied with your Lighting System, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.
Yours truly J F Conklin.

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, OCTOBER 29, 1887. No. 18.

Electric Lighting of a Railway Car.

Several months ago when the Pullman vestibule train was lighted by electricity, the officials of the Chicago Burlington & Quincy railroad were so pleased with the success of the system that they took immediate steps towards fitting one of their suburban cars with the electric light and storage battery. Johnson, Holland & Co. of Chicago, who equipped the Pullman train were awarded the contract for equipping the car in question. The two cuts Figs. 1 and 2, published in connection give a very good idea of how the work has been done. Fig. 1 shows the interior of the car with the lights in the ceiling. There are eighteen lights in the body of the car including one in the closet, and a light at each end of the car over the platform, as will be seen by Fig. 2, making a total of twenty lights. The car has been in daily use since Oct. 3rd on various trains and it is the most popular car in the service for riding after night-fall. There is an abundance of light and the patrons of the road, especially those who like to read the evening papers, are enthusiastic over it. The arrangement of the switches in the car is such that both rows of lights can be turned on or off, or both rows turned to half the candle power of the lights or either row turned on or off.

The exterior of the car, illustrated on the succeeding page, shows a somewhat different arrangement of the boxes for the crates containing the cells from that designed for the Pullman train. Particular attention has been paid to an arrangement that would reduce both the time for removing the battery for recharging and the labor of removal. It should be stated at this point that the trains of the Chicago, Burlington & Quincy road run into the union depot on the west side of the river and that the number of trains that arrive and depart from that station is so great that as soon as an arriving train discharges its load, it is immediately drawn out to the yard where it will be out of the way of other trains and is not returned to the station until it is time to receive its passengers for the outward trip again. This element in the problem was the one that necessitated arrangements having in view the least possible loss of time.

As shown in the cut, there are two boxes underneath the body of the car, the length of the boxes being at right angles to the length of the car. Into these boxes slip the crates that contain the cells of the storage battery. In Fig. 2 the crate is shown half withdrawn from the box. The truck on to which the crate is being moved was made especially for the purpose. The top of the truck is on a level with the bottom of the crate, and, as the crate is provided with rollers on the bottom, one man can very easily slide the crate from the box to the truck or from the truck into the box. When the man in charge has removed one crate he rolls the truck to the other side of the car and draws the second crate on to the truck. The truck is then rolled to the charging vault, a piece of sheet copper makes connection between the two crates, the charging wires are inserted, the current turned on and the battery is left standing on the truck to receive its charge. Meantime the car has been taken into the yard out of the way. When it is rolled into the station again later in the day the crates are replaced in the boxes. The time consumed in removing the batteries into or from the boxes has been reduced to an inconsiderable amount—so small that it need hardly be considered in the cost of the system for maintenance and all the work is easily performed by one man.

There are thirty cells to the car or two crates of fifteen cells each and a six hours' supply is readily yielded. At present the cost of charging the batteries is fifty cents per charge, which, as stated, would yield a six hours' supply, or eight and one-third cents per hour for the light, but the car in question has been on different runs lately, to use a railroad phrase, and there has not been so much demand for light as when it ran on a regular night trip out, and morning trip in, consequently it has been found that a change once in three days was sufficient.

It is understood that the Chicago, Burlington & Quincy officials are much pleased with the trial of the electric light on this suburban car, and are contemplating fitting up all their suburban cars in like manner.

Rubber not Always a Non-Conductor.

"When a man finds that hard rubber is not a non-conductor" remarked an electrician in a large Chicago establishment "it makes him feel as

Fig. 1.—Electric Lighting of a Railway Car.

though the earth were trembling beneath his feet," and continued his work of testing large hard rubber sheets. "We used to have a good deal of trouble with rubber that was a conductor but of late years the difficulty seems to have been removed until recently when another bad lot came in." Meantime with one eye on the galvanometer and the other on the sheet of rubber under test, he was rapidly moving his little brush holder with its fine brushes over the surface of the sheet. Suddenly the tell tale spot of light on the galvanometer flashed out of sight and the tips of the brushes sparked. "A bad spot" gently murmured the electrician and he rubbed the place in the sheet that appeared defective with a piece of tissue paper to remove the dust or moisture. Again he applied the brushes and again there was sparking whereupon the sheet was laid to one side. "No, we never have trouble with the interior of the rubber, the difficulty is always in the surface and we ascribe it to the rubber having been in contact with lead. Probably, the tin which formed the molds for the rubber was not pure but contained some lead."

Revision of the Patent Laws.

The committee on legislation of the National Electric Light association, consisting of J. Frank Morrison, of the Brush Electric Light company, of Baltimore, Md., Frank Ridlon, of the Sun Electric Light company, of Woburn, Mass., F. J. Sprague, of the Sprague Electric Railway & Motor company, of New York, Walter C. Kerr, of Westinghouse, Church, Kerr & Co., New York, and Arthur Steuart, of general counsel to the association, were directed at the last convention of the association to draft a bill, having for its object the establishment of a commission to revise the patent laws of the United States, and to take steps to secure its passage. The committee have completed that part of their labors regarding the drafting of the bill and it is appended:

"Be it enacted, By the senate and house of representatives of the United States in congress assembled:

Section 1. There shall be a commission to revise the patent laws of the United States, consisting of one chief commissioner and two (or four) associate commissioners; who shall be appointed by the president of the United States; and who shall hold office for one year from and after the date of their commissions; and who shall receive for their services, a compensation of $5,000 each.

"Section 2. It shall be the duty of the said commission to hold public sittings in Washington city, during thirty days at least, unless speakers are sooner exhausted, and to listen to whatever speakers ask to be heard on the topics within the jurisdiction of the commission, and to receive and consider all printed statements and arguments that may be duly delivered to the commission, relevant to those topics, and to invite communications from all the justices of the supreme courts, and all the judges of the circuit courts and district courts of the United States, and of the supreme court of the District of Columbia, and also from the commissioner of patents, and the examiner-in-chief, and the examiner of interferences, and the other principal examiners of the patent office, on the subjects before the commission, and to receive and consider such communications as may be duly made to the commission in pursuance of such invitations. And the commission may require reports in writing from the commissioner of patents, relevant to any fact or facts touching the rules or practice of the patent office, and the several commissioners may have access to all the books and periodicals in the patent office library.

"Section 3. The commission shall thoroughly examine the present patent laws of the United States, and compare them with the patent statutes of other countries, and thoroughly consider them in respect of their practical operation upon the progress of the useful arts, and upon the rights and interests of all classes of American citizens, and shall thereupon draft a bill for an act to revise, amend and consolidate all those statutes of the United States that relate to the organization or operation of the patent office, or to the granting or repealing of letters patent for inventions, or to the rights, remedies, duties or penalties which relate to such letters patent; and shall transmit that draft, together with a report of its doings and conclusions to the secretary of the interior, to be by him transmitted to the fifty-first congress, at the beginning of its session.

"Section 4. The commission is hereby authorized to employ such clerical aid and to incur such other expenses for room rent, books, stationery, printing, postage, etc., as it finds necessary for the proper performance of its duties, and

to receive reimbursement for the actual traveling expenses of its members incurred between their respective residences and Washington, on account of their duties as commissioners as well as their actual hotel bills in Washington during their official stay in that city.

"SECTION 5. The compensation and reimbursement due to the members of the commission, and the expenses incurred by them in the pursuance of the authority of this act, shall be paid from time to time by the secretary of the treasury, out of money not otherwise appropriated, on the certificate of the chief commissioner, approved by the secretary of the interior, that such compensation or reimbursement is due, or such expenses have been incurred, as the case may be."

Successful Electricians.

There is no subject more to the liking of general correspondents, nor, it must be confessed, one that they invest with more interest than that of the rapid advancement of electrical development and the success of the keen-witted men who stand behind it. Julian Ralph, a well-known New York writer, in a pleasant manner gossips as follows:

"One of the most peculiar and interesting figures in the electrical world is that of Mr. A. Cheever, of this city, familiar to all whose business takes them down town from the fact that he is a cripple, whose lower limbs seem never to have grown and who has to be carried about in the arms of a sturdy valet. Mr. Cheever's fortune is very large. It had its beginning in his father's interest in a great rubber belting concern and has been swelled by his own investments in the telephone and other electrical companies and in his business as a wire manufacturer. He lives in luxury at a fashionable resort near New York whose growth has been largely due to his remarkable shrewdness and enterprise. It seems almost like a fairy tale and must dwell in his mind like a dream, yet it is a fact that not many years ago he had the Bell telephone interest in his hands and let it go. It was offered to him for a mere song. Tillotson, the electrical supply man, just dead, could have bought either a third or a half interest for $20,000 or $40,000 and refused it. The company had no money to exploit with and could not raise any. The history of electrical progress is full of such junctures as amazing if not as important as that one in 1843 when the vote of the state carried the bill to give Professor Morse $30,000 which led to the telegraph of today. He could not raise the money elsewhere, and it is frightful to think what the world's loss

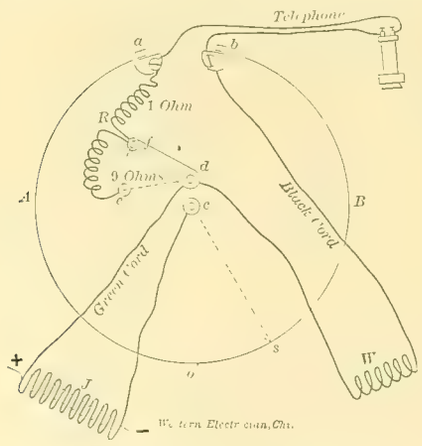


FIG. 1.—TELEPHONE BRIDGE.

might have been had the bill failed to pass congress.

"Of men who like the eleven who went into this new field of the cloth of gold with their money in hand and who profited largely by their boldness there are many. George Westinghouse, jr., the air brake inventor of Pittsburgh, has multiplied millions by plunging into the manufacture of electrical essentials like dynamos, lamps and other devices. He has invested in all forms of electrical speculation and is worth ten millions. There is C. A. Coffin, the shoe manufacturer of Lynn, who had to be dragged into investing his means in the Thomson-Houston company and yet now gives the interest half his time. R. T. McDonald, the keenest man in this school in the west, who is treasurer and general manager of an incandescent company headquartered at Fort Wayne, is either a millionaire or soon will be.

"The first of all electrical millionaires was Cyrus W. Field, who is still a millionaire, but no longer of the first rank since his losses in Manhattan elevated stocks. His losses have been largely the gains of that arch millionaire Jay Gould, who holds something like forty millions of his wealth in the electricity that runs the great telegraph system of the country."

Telephone Bridge.

This little pocket apparatus, constructed by Dr. Nippoldt, explains *Électricité*, has for its object the approximate measurement of the resistance of earth connections. In similar measurements great exactness is not of importance; the variations which these resistances can undergo renders it insignificant; it is rather of importance to know what is its order of magnitude, whether it is a little more than an ohm, or comprised within one and ten, or ten and a hundred ohms.

In the telegraph it is rarely necessary to make such measurements; the number of elements themselves render account of the state of the contacts. There is not, however, any difficulty in establishing a connection with the earth of 50 to 100 ohms, and it follows in consequence of the great resistance of telegraph lines, that they have little internal disturbance, at least in the case of a single line. If, on the contrary, it is desired to put in operation a great number of telegraph lines, the derivation of which branches out of a central station, by means of a generator of low resistance, the earth connection should be very much better. In a large city this is always easy, it being given that the network of conduits of water or of gas is arranged, the resistance of a similar earth connection is sensibly *nil*, and there is no necessity of its being measured. But if in telegraphy an instrument intended for this measuremement has less of interest it is entirely otherwise in the case of conductors and lightning rods.

The experiments of M. Toepler have shown that, even with a resistance of a few ohms, a conductor can give place to a branch derivation from the main discharge, and that this danger was as much less as the earth connection was better. It is therefore of great interest to be able to assure one's self easily of the state of the conductors, and a portable apparatus, of a very simple management is called for to render service in this branch of electrotechnics.

The principle employed by Dr. Nippoldt is the same that was first utilized for avoiding polarization in the measurement of the resistance of electrolytes. This principle is based upon the employment of alternating currents, adjacent to those in a telephone, as E. Kohlrauch has shown, instead of an electro-dynamometer.

The constructor makes use, in his apparatus, of a telephone as compact as possible, that of the firm of Hartman & Braun, of Frankfort, and the entire bridge, comprising a wire measure with its movable contact, and two resistances of comparison [bridge of Kirchhoff] is mounted upon the telephone box.

Fig. 1 shows the plan of the apparatus. *A B* is the caliber of the case in which the coils are inclosed, *R* two resistance coils, one of one ohm, the other of 9 ohms. They can also, by means of the switch *d f*, have a resistance of comparison of one or of ten ohms. The resistance to be measured is interposed between *b* and *d*; *c s* is the movable contact; finally the alternate currents are furnished by the secondary circuit of the induction coil *J*, attached at *d* and *c*; the telephone wires start from *a* and from *b*. The alternate currents are produced by an induction coil, excited by a dry pile; the whole placed in a leather case, as shown in Fig. 2.

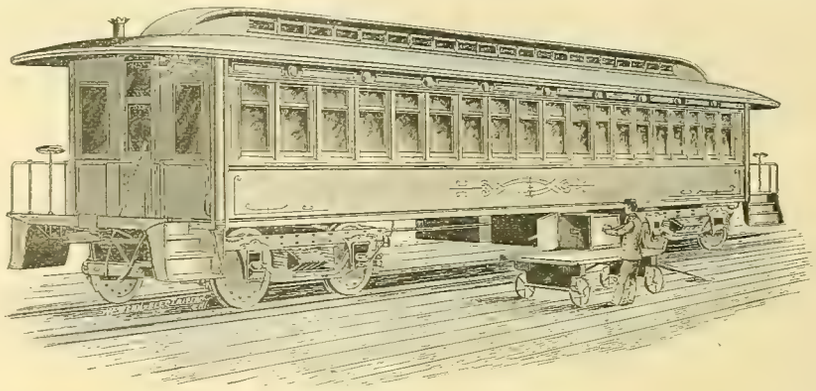


FIG. 2.—ELECTRIC LIGHTING OF A RAILWAY CAR.

The four wires, two for the induction coil and two for the exterior resistance, are united in a cable cord, the extremities of which are furnished with tips for attachment. A scale is fixed upon a movable ring around the cover, and it can turn 330°; the movable contact is also attached to this, and the wire of this last is placed in the interior of the case. The index of the scale is fixed upon the same box and the readings are given directly in ohms. The readings can give from .1 to 100 ohms; the contact permits of measurements from .06 to 150 ohms, which facilitates the connection at the point.

Cost of Telegraph Lines.

D. H. Bates, president of the late Baltimore & Ohio company, and now a Western Union employe, says "the Baltimore & Ohio telegraph

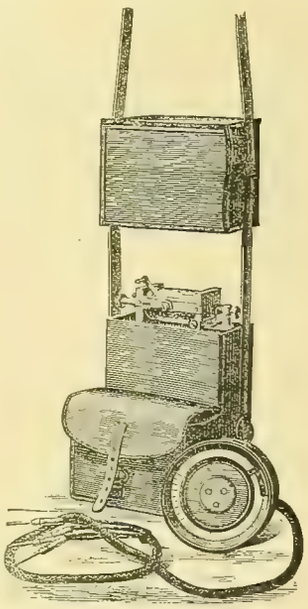


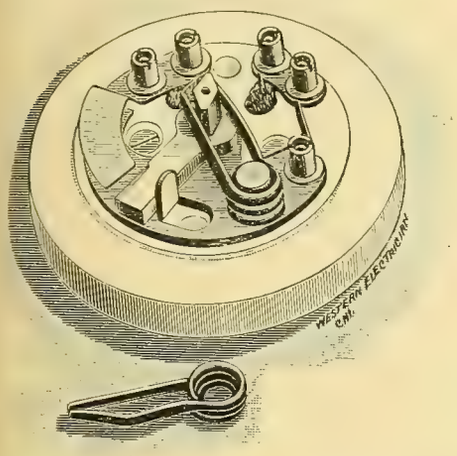
FIG. 2.—TELEPHONE BRIDGE.

company for two years and a half, until last April, not only paid its expenses out of receipts, but had a small balance remaining after having paid the Baltimore & Ohio railroad company at the rate of nearly $100,000 per annum for use of wires and offices on the Baltimore & Ohio roads, and for the district call box plants in the various cities within the limits of the Baltimore & Ohio system, besides paying for all instruments, battery and other telegraph supplies for the entire railroad train service." Mr. Bates also

says that the actual cost of the telegraph lines, comprising 52,600 miles of wire, nearly all of it copper and large gauge iron, was just about $4,000,000, as the Baltimore & Ohio ledger shows, so that the railroad company got nearly cost for it.

A Porcelain Electric Light Switch.

The switch shown in connection was designed by Dorman & Smith of Brazennose street, Manchester, England, principally for house or ship lighting by the incandescent system. *Idustries* calls especial attention to the merit the switch



possesses of a rapid break of contact effected by the form of spring employed and describes the features of the instrument: "The brass contact making arm is fitted with a diamond of lozenge shaped shoulder, on the broad edges of which the ends of a powerful tempered steel spring are caused to work. At the instant of breaking contact, the brass shoulder is clasped at the ends of its longer axis by the spring, which has therefore a very powerful turning moment. It is claimed by the inventors that no trouble is experienced from sparking when contact is broken, whilst it is impossible for the switch to be left only half on. Either a good contact must be made, or none at all. The whole is mounted on a porcelain base, and ornamental porcelain covers may be provided of any desired shape or color. A lead wire safety fuse is inserted on the same base, and every precaution apparently taken to prevent possible sparks from reaching wood work. The whole of the connections are made on the upper surface, and some amount of trouble is thereby saved.

"These switches are primarily meant for use with small groups of glow lamps, up to about five in number; but we understand that in the Manchester exhibition even single arc lamps burniug with a current of 10 ampères are put into or out of action by the use of these hand switches alone."

Lithanode

In the course of the investigations which were conducted on the accumulator which bears his name, Mr. Fitzgerald has been led to employ as a negative element a special substance, to which he has given the name of lithanode, and which, according to him, constitutes a negative element *par excellence* for a battery, an accumulator, or an anode, perfect in the electrolysis of elements, chiefly negative elements, as chlorine for example.

In his report to a committee of the British association, the inventor recounts at the outset the conditions which ought to furnish a substance employed for this purpose. The negative element of a battery ought to be not only strongly electro-negative, but it should also be left remaining for a greater or less time when it serves as the cathode. The electro-negative element ought not to be associated with an electro-positive substance in such a way as to be in contact with the electrolyte, to avoid local actions, in short it ought not become disintegrated or corroded. From the standpoint of economy, the total cost of the electric energy produced by batteries or accumulators ought to be as low as possible, and the relation between work produced and weight ought to be high; finally, the negative element ought to be as good a conductor as possible.

According to the inventor, lithanode is the only negative element which fulfills these conditions. A substance employed as an anode for electrolytic decompositions ought not to be attacked by chlorine and oxygen in the nascent state, nor disintegrated by escaping gas. The substance called lithanode, and which has been known for some time in France and in England, is from peroxide of lead, under a form dense and conducting, obtained without the combination of a cement or a glutinous material by the method briefly described by the inventor in April, 1880.

Plantè obtained the peroxide of lead under the form of a thin layer in contact with metallic lead; the invention of Faure has since permitted the obtaining of a layer as thick as may be desired, but it has the disadvantages of requiring the employment of parchment, of giving place to defective contacts between the lead and the peroxide, and of local actions which end by bringing about the destruction of the lead plate.

The Faure-Selon-Volckmar accumulators employed by the Electric Power Storage company present not only the first two inconveniences, but are also open to the last objection. In order to realize this last improvement it was necessary that the negative element should be formed of a coherent mass not requiring a metallic support; he therefore failed to obtain a compact mass of peroxide of lead, without the combination of some foreign material.

If the oxide of lead is mixed with water, and if it is molded as a paste so as to obtain the form of a plate, it will become perfectly brittle when it is dried; it is therefore necessary, in order to arrive at the result sought for, to produce a change in the molecular structure of the mass. If, for example, there is added to the paste, lead under the form of a fine powder, the gradual oxidation of this finally gives to the mass a great cohesion. The plate, peroxidized by electrolysis, constitutes the product decorated by some electricians with the barbarous name of petranode.

The better process, and that which is employed by Mr. Fitzgerald, consists in mixing the oxide of lead, the lead, and a solution of a salt which will be gradually decomposed by the oxide, as, for example, the sulphate of ammonia, which will then disintegrate the ammonia, whilst a certain proportion of the oxide of lead will be transformed into sulphate of lead. This mass converted by the electrolysis of the peroxide of lead is lithanode.

From this it appears that this substance is almost identical with the active material of the anodes of a certain number of accumulators. The difference consists in the physical state which permits not only the employment of the peroxide, but which avoids all local actions, and besides imparts to this highly conductive mass a mechanical resistance sufficient for resisting, during an indefinite period, the effects of charge and discharge.—*Electricité.*

Combined Clock and Automatic Guest Call.

The Harford Electrical company, of East Saginaw, Mich., are manufacturing a combined clock, automatic guest call and instantaneous fire alarm which has the merit of being very simple, complete, sure and durable. While designed more particularly for hotels, the apparatus will undoubtedly come into general use in the better class of private houses.

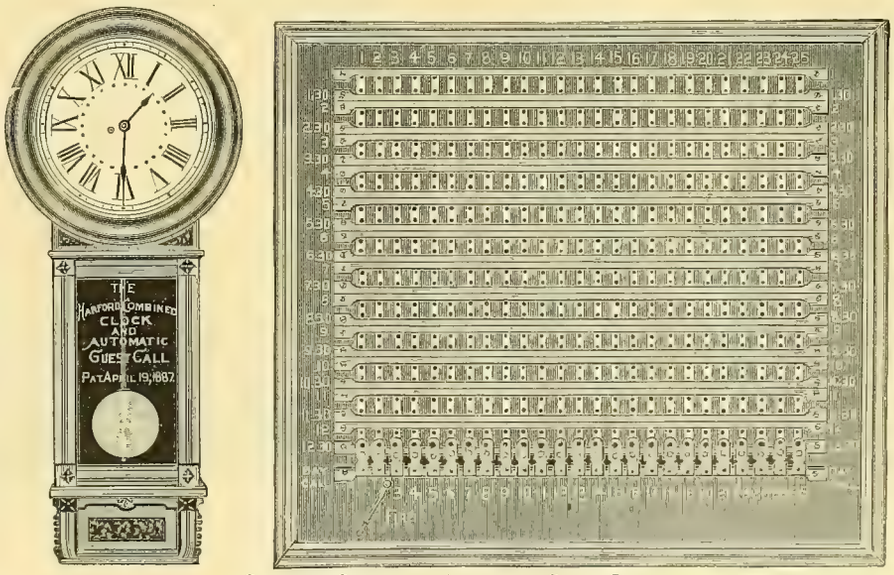
The apparatus as shown by the illustrations, consists of the use of an office clock and a switch board showing room numbers, which are placed in the office of the hotel. As any annunciator can be used in connection with the system it is not necessary to show that part of the whole.

The switch board is mounted in cabinet work of modern design, and makes a rich addition to the furnishing of any hotel office. It is compact and any available wall space can be utilized.

In each room of the hotel are placed the common push button and electric bell; the batteries are located in the cellar or otherwise, as desired, and the whole is operated as follows: If one or more guests desire to be called at, say, 5 o'clock, the clerk simply inserts a common switch board pin in the room numbers on the switch board, of the rooms occupied by the guests desiring to be called. If other guests wish to be called at 5:30 o'clock, pins are inserted in their respective room numbers, and so on for all the whole and half hours of the day and night. Any number of guests can be called at any or all the whole or half hours. No further attention need be given to the matter, as, when the hour hand of the clock reaches 5 o'clock, all the rooms switched on to that hour have the electric bells in their respective rooms rung automatically until the guest arises and pushes his push button, when the annunciator drops, thus indicating that he has arisen; the clerk can then remove the pin from the room number of the switch board indicated by the annunciator, or he can leave it there, as the bell in the room will cease ringing in from one to four minutes, although it can be arranged to ring any length of time desired. The same follows with guests desiring to be called at 5:30, 6, 6:30, etc.

The foregoing constitutes the automatic night and day call. If it is desired at any time to immediately ring the bell in any room, the clerk simply pushes on one of a number of springs numbered to correspond with the numbers of the rooms, and immediately the bell in the room of like number rings; one can ring it as often as he cares to by easing up on the spring and again putting on the pressure.

In the event of a fire, or when a general alarm is necessary, the fire lever is moved over and it instantaneously and simultaneously rings all the bells, which continue ringing until the lever is released.



Combined Clock and Automatic Guest Call.

The Cost of Domestic Electric Lighting.[1]

By Sir David Salomons.

Part III.

Private electric lighting installations are on the increase, but only slowly. There are even at present many owners of country houses who erect private gas works in ignorance of the great advantages to be derived from the electric light. In fact this new light is still regarded with suspicion by those who have not a full knowledge of the subject. This, however, is but natural; it is well known that there is scarcely an installation existing where breakdowns do not occasionally occur, and besides, experience has shown that tenders for erecting the work vary so much that the intending installer is puzzled, and either leaves the matter alone, or, worse for him, selects the lowest tender. An electric light installation must be done thoroughly well if it is to be satisfactory, otherwise it is best left alone, saving expense and vexation after the work is supposed to have been completed. Like most other things, whatever the first cost may be, the best is the cheapest in the end, and intending users of the electric light must make up their minds to pay well at starting, and employ the best men to be found for the work. Under these conditions the money spent will soon appear profitable, and bring advantages little dreamed of, without a shadow of trouble or annoyance.

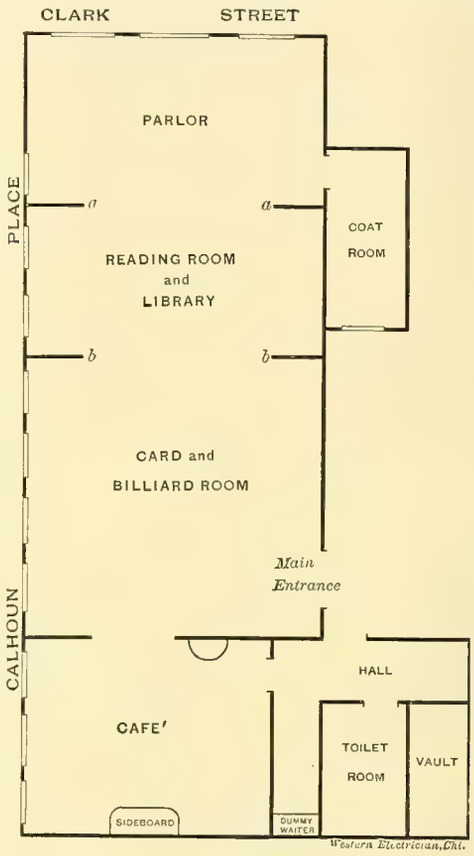
The writer was one of the first to light by electricity in England, so far back, indeed, as 1874, in a primitive way; and from that time till now one installation after another has been erected at Broomhill. He has also designed many others for friends who wished to obtain the results of his experience, and has therefore had ample means of ascertaining the expense of erecting installations of various kinds as well as the cost of maintenance. His present object is simply to give a general idea of the expense of erecting a good electric light installation as thoroughly as knowledge, time, and money can do it, and the figures given may be taken as absolutely within the mark for the very best, but beyond it for medium work. The best is strongly recommended, being most satisfactory not only for endurance, but for daily convenience, as it permits of a regular light for 24 hours of the day under all circumstances, and the illumination given by any lamp will practically be invariable. There are three ways in general of erecting the work. The first is one which enables the owner to obtain light only while the engine is running. The second, and a much better way, is to use an accumulator from which light may be obtained at all hours of the day, whether the engine is running or standing. In this case certain precautions have to be taken to avoid injury to the lamps, and the man in charge must act accordingly. The third, and by far the best way, although the most expensive to erect, is to work on the second method, and have all the necessary precautions automatically performed. It is not intended here to deal with technicalities, the various methods of accomplishing the results spoken of have been briefly described in the second edition of a little book recently published by the writer. Here we only deal with figures. Every installation must consist of a prime mover of some kind, dynamo, a circuit of wire to lead the current to the lamps, certain measuring apparatus and instruments for turning on and off the current, termed switches. A governor to secure regularity in the light is often added. If a storage system is used, then an accumulator must also be erected, and some further apparatus; if perfection is desired, two electrical governors and some automatic switches should be included. Of course, safety fuses or cut-outs must always be employed to secure perfect freedom from accident and fire. If an installation is well put up, the general fire risks are practically reduced to *nil*, no lamps, candles, or gas light being required in the establishment; but an installation badly erected is always a source of danger. Direct currents are best to use in private installations. The engine may be actuated by gas, ordinary high pressure steam, or low pressure steam, as in the Davey motor, or again may be worked by hot air or water. Engines on the last named principle are seldom, however, made sufficiently large for the purpose.

(*To be Continued.*)

[1] From *Industries*, October 7th.

Chicago Electric Club.

The diagram published on this page gives a clearer idea of the arrangement of the new rooms of the Chicago Electric club than could be gained from a description. The rooms are over 122–124 Clark street at the corner of Calhoun place, and are reached by a single flight of stairs from the floor over the basement. The committee, Messrs. Buckley, Shain and W. A. Stiles, have expended much time and labor in renovating the rooms and furnishing them in a tasteful manner. The original entrance from the hall was through the coat room, but it was deemed better to make the



main entrance through the door indicated into the card and billiard room. At *a a* and *b b* there are curtains which divide the main room into a parlor, a reading room and library, and a card and billiard room. These curtains, when moved back to the walls, throw the whole into one large assembly room about sixty feet long by twenty feet wide. In rear of the card room is the café, which is provided with a lavatory. A handsome side-board graces the room, and the tables, chairs, linen, glass and silver ware will soon be in place. To the right of this room is a hall which leads to the dummy waiter. Next is the toilet room, and adjoining it is the vault for the records of the club. In place of carpets on the floors there are handsome rugs which are well set off by a filling of a deep wine color. The portieres are also of a solid wine color, and give a rich effect to the rooms. The furniture is oak, ash and cherry, and all of the most modern design.

Preparations are being made for putting in the electric light. The Chicago Arc Light & Power company will furnish the current, and the Edison, United States, Fort Wayne Jenney, Mather and Vitrite & Luminoid companies will furnish the lamps.

The organization of the club has been—so to speak—upon a social and a scientific basis, that is, while scientific papers have been and will be read and discussed at stated meetings, the social element will not be forgotten. To the latter end, the rooms have been especially fitted. They are in charge of a porter, and are open at all times. Members engaged in electrical business can meet at the club rooms on a common footing and entertain their friends there. The café will soon be ready for occupancy, and members will find it a pleasant place to take a midday lunch.

The roster of the club is appended:

President, A. K. Stiles, 17 North Clinton street.

First Vice-President, C. A. Brown, 227 South Clinton street.

Second Vice-President, J. P. Barrett, City hall.

Third Vice-President, B. E. Sunny, Pullman building.

Fourth Vice-President, F. G. Beach, Pullman building.

Secretary, W. A. Kreidler, 6 Lakeside building.

Treasurer, F. S. Terry, 171 Randolph street.

Board of Managers, C. A. Brown, F. S. Terry, W. A. Stiles, W. A. Kreidler, W. J. Armstrong, W. J. Buckley, J. P. Barrett, Chas. D. Shain, B. E. Sunny, C. C. Warren.

Membership committee, C. A. Brown, W. J. Armstrong, Chas. D. Shain, F. S. Terry, W. A. Kreidler.

Entertainment committee, H. Ward Leonard, A. H. Brown, J. L. Barclay, Chas. D. Shain, C. C. Haskins.

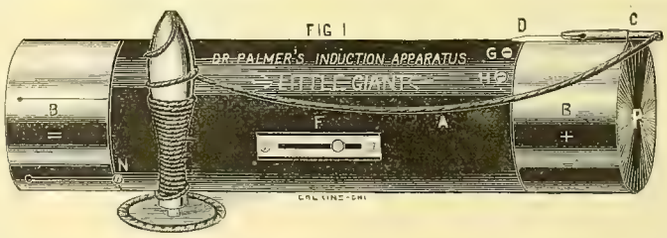
The roll of members now contains 159 names. As there is a question as to the mode of procedure in securing admission to the club, it may be stated that applicants can secure application blanks from members of the club. These blanks must be filled out and bear the indorsement of at least two members of the club. The application may then be mailed to C. A. Brown, chairman of the membership committee, 227 South Clinton street.

The next meeting of the club will be held November 7th.

The Palmer Induction Apparatus.

The illustration in connection shows a half reduction in size of a new volta-faradic induction apparatus, made by Dr. Palmer, of Evanston, Ill., and on which he has applied for letters patent. The battery is very simple, compact and convenient, and is designed for general medical or private use.

Letter A is the hard-rubber tube; B B, nickel-plated caps; + the positive and = the negative electrodes of the battery; C, the receptacle for holding a conducting cord, for use in special cases only. By means of the commutator D, projected from positive electrode B, made to slide over G and H, the terminal points of the primary and secondary wires of the helix, the energy of the current can be varied, and the slide button F controls the force of the shock produced with the greatest nicety. A closed battery cell and a helix with a rheotome, arranged



to give longer or shorter sweeps of the spring, are securely fixed within the rubber tube.

A week ago Friday a meeting of west side residents of Chicago was held to consider the question of rapid transit by means of an elevated road. Sooner or later some decisive steps will have to be taken in the way of furnishing more rapid transit than is at present afforded by either the street cars or the railroads on the west side to the suburbs. An electric surface railway would be open to the same objections in regard to speed that surface steam railways are, but an elevated road, on which the cars are propelled by electricity, would make the ideal rapid transit line.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

NUMBER XV.

The Westinghouse Dynamo Continued.—The object of this dynamo being to generate an electric current at a high potential, and pass

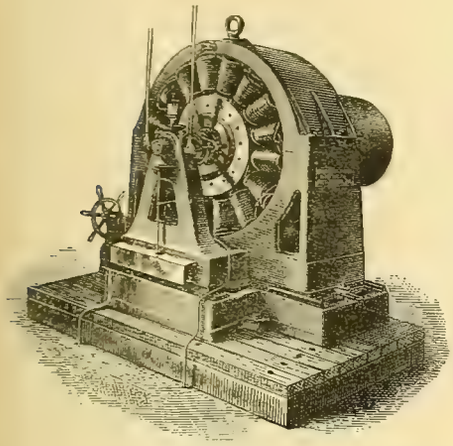


Fig. 42.

it primarily through a high resistance, better results are obtained by the use of a separate exciter than by attempting to attain this end directly. A Stanley, constant current, shunt wound dynamo is used for this purpose; the wires connecting with it being shown at the base, Fig. 42, while the wires extending upward from the collector connect with the lamp circuit.

The weight of the largest machine is 13,500 pounds, its speed 1,175 revolutions per minute, and the electro-motive force employed in the main circuit from 1,000 to 1,100 volts. It feeds 2,500 incandescent lamps. By the screw shown near the base at the right, the machine can be moved on its base to regulate the tension of the belt.

A very important feature is the converter, which may be described as an inverted induction coil. The ordinary induction coil is made with two helices insulated from each other; an external helix of long, fine, insulated copper wire, hav-

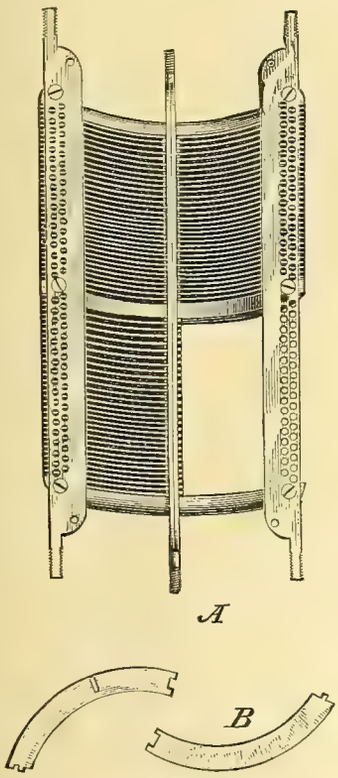


Fig. 44.

ing a high resistance, incloses a helix of shorter, coarser wire, having a low resistance, and this incloses a core composed of a bundle of iron wires. The interior helix, known as the primary, when connected with an electric generator magnetizes the core, which by reciprocal action, increases the intensity of the electric current; and the primary circuit being opened and closed with great rapidity by a circuit breaker, a series of alternate currents in opposite directions, is induced in the secondary circuit; the intensity of these induced currents as compared with those in the primary being increased in the direct ratio of the increased resistance. In such a coil current intensity is increased at the expense of current quantity, but in the converter quantity is increased at the expense of intensity. This is effected by connecting the high resistance coil with the generator, and the low resistance coil with the lamp circuit; the alternation being produced in the dynamo.

In the induction coil the core being in the center, is separated from the secondary helix by the interposition of the primary, and hence its magnetizing effect on the secondary is reduced as the square of the distance represented by the thickness of the primary. In the Westinghouse converter this arrangement is partially reversed, the two coils being placed side by side, and inclosed within an iron envelope which fulfills the magnetizing function of the core, both coils being thus brought into close contact with the iron. This closeness of contact is effected more perfectly by dividing the converter into connected sections having thin coils than by using a single large converter requiring great thickness in the coils. The magnetizing envelope is composed of sheet iron plates, insulated from each other, placed at right angles to the longer axis of the elliptic

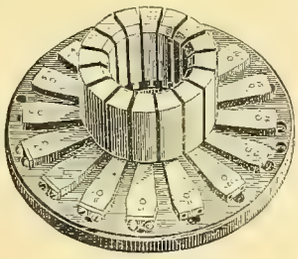


Fig. 46.

shaped coils, built up around them, and bolted together; the proportion of iron in the envelope to that of copper in the coils being as $2\frac{3}{4}$ to 1. The loss from electrical conversion in a reduction from 1,000 volts in the primary to 50 in the secondary is said not to exceed 5 per cent.

The Jenney Dynamo.—This dynamo is constructed with two horse-shoe field magnets, placed horizontally, with consequent poles in the center between which the armature revolves. Each pole-piece with the two cores which it connects, and one-half of each yoke, forms a single casting, the upper one resting on the lower at the center of each yoke, where they are bolted together, these being the only joints, magnetic continuity being thus more fully secured than in a construction requiring several such cross joints at right angles to the magnetic current.

The armature is of the Pacinnotti-Gramme type, and is mounted on two yokes, curving outwards and bolted to the machine on opposite sides. Its core is composed of insulated sheet iron rings, attached to spiders mounted on the shaft in the usual manner. The general construction and method of winding, is similar to that of other armatures of this type.

The automatic movement of the brushes to vary the magnetic intensity is also a feature of this dynamo.

The Hochhausen Dynamo.—The general construction of this dynamo will be readily understood from Fig. 43, its special distinguishing features are found in the construction of its armature, and commutator, and in its automatic current regulation and short-circuiting switch.

The armature core, shown in section at *A*, Fig. 44, is composed of iron ribs, two of which are shown at *B*. These are about $\frac{3}{32}$ of an inch thick, and have projections at the ends which fit into holes in the longitudinal bars of the frame, as shown.

There are four longitudinal sections constructed in this manner, forming, when joined, a hollow cylinder, each longitudinal bar being in two parts held together by nuts and screws at the ends, and by iron staples between the ribs, so that any section can be removed without disturbing the others. The ribs are separated for ventilation as shown, and the staples between them give a firm bearing for the end screws. The core is without magnetic or electric insulation.

The coils which are shown in Fig. 45, singly at *C* and in combination at *D*, are wound sepa-

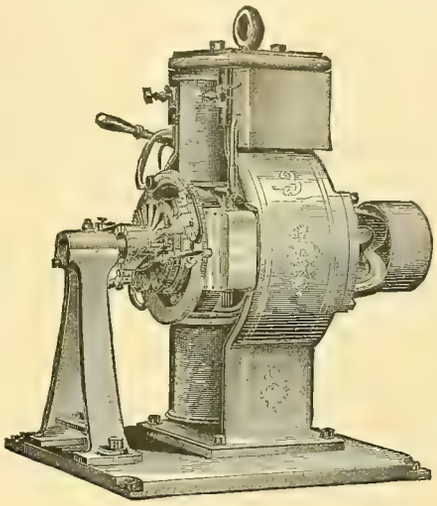


Fig. 43.

rately on a mandrel, and each one firmly bound together, and they are subsequently slipped on the separate sections of the core and properly connected; so that any coil can easily be removed and replaced when repairs are required.

In the commutator, shown in Fig. 46, the segments are attached to a thick disk of slate which is mounted on the shaft; each segment having an arm for attachment as shown, so that they project into the air, and are insulated from each other and from the shaft, both by the air and the slate. Four brushes make contact with the commutator, two on each side, the brushes of each pair being placed side by side,

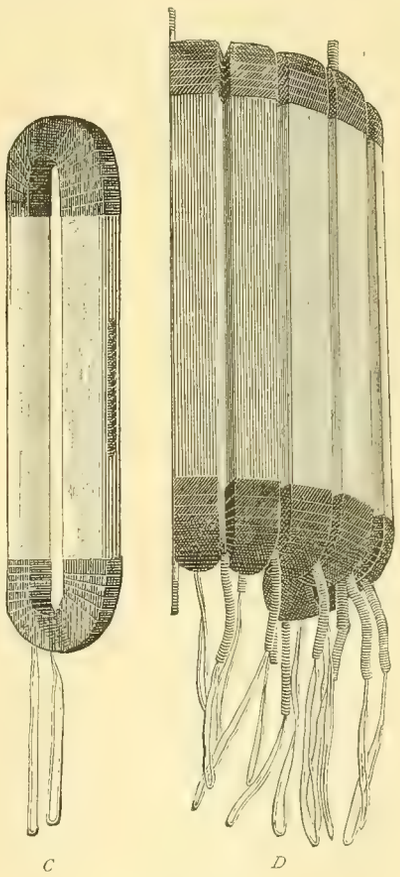


Fig. 45.

one a little in advance of the other, so that one brush is always in contact while the other is crossing from one segment to the other.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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THE subject of taxing telephones was again before the Chicago city council at its last meeting and was again referred to the law department.

THE article on lithanode has a special interest at the present time when attention is being directed to improvements in the construction of accumulators. If this new-found substance should prove to have the various qualities of excellence claimed for it, especially those of cohesion and durability, it will be hailed as a boon to those interested in accumulators.

THE description of the telephone bridge, reproduced from a French contemporary, shows how the telephone may be utilized for the measurement of electric resistance. The apparatus reminds one of the well-known induction balance by which, it will be remembered, an attempt was made to locate the bullet in President Garfield's body; and its construction bears a striking analogy to that instrument.

A RUMOR that seems to be gaining strength with its circulation has been floating in electrical circles in the west to the effect that the United States Electric Lighting company and the Westinghouse company would hereafter work in harmony in regard to the alternating system, or, in other words, that questions of difference had been settled privately between the two companies.

When approached in regard to this matter last week, Herman Westinghouse, brother of George Westinghouse, jr., denied the rumor, and added somewhat significantly that all the indications pointed the other way.

It is encouraging to notice the increased interest in electric lighting in the Chicago city council, as shown by the introduction of an ordinance at its last meeting, calling upon the superintendent of the fire alarm telegraph for an estimate for lighting an extended territory by the electric light. The old axiom that large bodies move slowly was never more strikingly exemplified than in the history of street electric lighting in this city. While small towns all around are enjoying the electric light, and have had it for years, Chicago adheres pertinaciously to gas; and the feeble, sickly flames of street lamps still cast their mournful shadows under the brilliant arc lamps hung over store fronts by enterprising business men,—a sarcastic commentary on public as compared with private enterprise.

EIGHTEEN hundred subscribers of the New England Telephone & Telegraph company, using about 2,500 instruments, have addressed a remonstrance to the senate and house of representatives of the commonwealth of Massachusetts "against the passage of any act to establish the rates to be charged for telephone service, on the ground that the operation of such laws would be to impair the quality of the service and lessen its value; that the subject was fully and thoroughly considered last year, and that the decision not to undertake to fix telephone rates has been accepted by the public as wise and as consistent with the general policy of the commonwealth." The signatures to the remonstrance come from Boston, Adams, Fitchburg, Gloucester, Haverhill, Lawrence, Lowell, Lynn, North Adams, Northampton, Pittsfield, Salem, South Framingham, Springfield and Worcester.

This action on the part of so many subscribers is significant.

WE publish on other pages that portion of the proceedings of the street railway convention in Philadelphia last week, of interest to electricians. In the report will be found a paper presented by Wm. Wharton, jr., on electricity as a motive power for the propulsion of street cars. The facts are in the main the same as have already been presented in electric conventions, but it is highly encouraging to find them brought directly to the attention of the street railway men in so able a manner.

The question of the superior economy of electric traction as compared with that of cable or of horse traction was fully demonstrated, and it is especially noticeable, that even at the low estimate of the utilization of only 40 or 50 per cent of the power generated, electric traction is still shown to be more economical than cable traction, in which only 20 to 25 per cent. of the generated power is utilized; while cable traction is in turn admitted to be more economical than horse traction.

JAMES A. MURPHY & CO., said to be bucket-shop men of Chicago, secured a temporary injunction against the board of trade, restraining it from cutting the wires out of the former's tickers. The board moved to dissolve the injunction, but last week Judge Collins denied the motion. The decision is exhaustive and commences with the organization of the board, which was incorporated in 1859. It shows how the board ruled that its quotations were private property and should be sent only to those whom it designated as adopted members, then indicates that the predecessors of Murphy & Co. became approved correspondents, and then takes up the question what are the quotations or market prices claimed as public property by Murphy & Co. and as private property by the board. The court says on this point:

"It seems to the court that these fluctuations in the market created by the defendant [the board of trade] are of most vital interest to the public outside of the mere fixing of values; that they exert a constant and steady influence on loans and discounts, the price of money, business stability, and public confidence, as well as on the price and value of so much that the people must buy. If such power and responsibility rest with any one man or any set of men of any description there exists therewith a corresponding duty and obligation to the public to impart alike to all who desire and will pay, equal information as to the progress and result of the work."

The court then continues: "That these quotations are of no use except for gambling purposes is answered by the existence of 1,500 approved correspondents who are not gamblers, and to whom daily they are transmitted. Further, it is urged that bucket-shops cannot be suppressed unless the board have this power of discrimination. They should be suppressed, and the court would go far to accomplish so desirable an end, but regarding this claim of the right to discriminate as more dangerous to the public in its consequences than the bucket-shops, we must look to the enforcement of the criminal code as the safer course of the two."

Though the court sharply raps the bucket-shop men in the preceding clause, he gives them comfort in that section in which he declares that it is the board's duty to impart alike to all who desire ond will pay equal information as to the progress and result of the work. On the whole the bucket-shop men are much pleased, even though the victory may be temporary.

WE publish this week the bill drafted by the legislative committee of the National Electric Light association in accordance with the instructions given it at the last convention. The object of the bill is the appointment of a commission to revise the existing patent laws. The bill has been printed in a pamphlet which, we presume, is now in the hands of all the members of the association. Within the covers of the pamphlet are able arguments from Arthur Steuart, of general counsel to the association, Albert H. Walker, of Hartford, Conn., Benjamin Price, of the legal firm of Price & Steuart, and Ephraim Banning, of Banning & Banning, of Chicago, in favor of the bill.

To say that the existing state of affairs in the patent office and patent laws is unsatisfactory, is but to mildly recognize a fact that has been impressed upon every man who has had any connection with the patenting of inventions, and a fact that has been repeatedly brought to the attention of the public through the efforts of associations, notably the National Electric Light association.

Mr. Steuart points out several evils, and suggests certain remedies. As the staff of examiners in the patent office have charge of interests of a vital nature, they must be thoroughly educated in the technology of the arts and sciences and patent law; a staff of competent and thoroughly equipped examiners should be retained through a number of years; the examiners should be relieved from all political influence. The patent office building, he argues, was built with money paid to the government by patentees, but the patent office is restricted, hampered and impeded in the transaction of business by other branches of the interior department; separate accommodations should be provided for these other departments, and the patent office given the additional room, and a laboratory should be provided for demonstrations. He then indicates the fact that the rights to be granted a patentee depend upon the statute law first, and then upon the interpretation of that law by those empowered to grant rights under it, and therefore that unless interpretations are uniform, and the rules of practice clearly defined, great injury may result to the rights of patentees. Practically the examiners, of whom there are about 200, are the real judges of both law and fact, and unless the practice of the office and the interpretation of the law is clearly settled, this subdivision of jurisdiction must lead to great disparity of ruling. The office of commissioner of patents has not been held in many years by any man who knew anything about patent law or patent practice before he took the position, and of late years no man has held that position for more than two years together. Mr. Steuart pleads for the establishment of a permanent court, the judges of which should hold office during good behavior, and who should be chosen from the prominent patent lawyers of the country or promoted from the ranks of the patent office examining corps.

Mr. Walker takes up a number of sections of the revised statutes, and indicates faults that should be corrected and omissions that should be supplied, although both are too numerous and complex to be explained in so brief an essay.

Mr. Price hits the administration of the laws some straight arm blows, and suggests changes.

Mr. Banning advocates a greater clerical force to do the work, and more space in which to do it; its highest judicial tribunal should be a court consisting of five or seven judges; a thorough and rigid examination into all questions touching the novelty and patentability of every invention presented should be had; the commissioner should be relieved from judicial duties and have special charge of everything pertaining to the executive work of the office; lastly, the salaries of the commissioner, judges and principal examiners should be increased to such amounts as to command the best talent of the country.

As a whole, the pamphlet contains a strong arraignment of patent office methods and laws and as well the suggestions of sound thinkers in the line of improvements. The matter is one of engrossing interest, and one that, with its able presentation, should be impressed upon the members of the next congress.

Street Railway Convention.

The sixth annual convention of the American Street Railway association was held in Philadelphia last week, commencing on the 19th inst. The attendance was large, and much interest was manifested in the proceedings. The growing importance of electricity as a motive power was recognized, and no part of the proceedings engaged closer attention than the papers or remarks pertaining to this subject.

William Wharton, jr., read the appended paper on

ELECTRICITY AS A MOTIVE POWER.

Since the last annual meeting of this association the subject of using electricity as a substitute for horse power on street railways has received much attention, and great advances have been made in the practical application of it to that purpose, so that it may now be stated broadly there is no longer any doubt or uncertainty that electricity can be successfully and economically employed in a great many places, if not most places, as a substitute for animal power. Quite a number of electrical railways are in operation in the United States, running satisfactorily under all the requirements of public service, so that there is much greater familiarity with, and a more general knowledge of, electricity among railroad men and the public than ever before. There is so much confidence in the practicability of of electrical propulsion of cars being well es abl shed, that the subject is no longer treated with doubt or disdain ; on on the contrary, great interest and respectful attention are at once manifested whenever the subject is brought up. Although some parties, interested, perhaps, in pushing forward their own special inventions, may claim too much, the actual facts, as presented daily in the regular work of the cars, are good enough to warrant this belief and confidence. Electricity in its manifestations, applications and capabilities, has been hitherto a subject the knowledge of which has been confined mainly to scientific circles but it is evident that the time has come when it will be put in harness in place of the horse to draw cars, and to perform many other duties which a few years ago would have been considered entirely chimerical and visionary. So long as the oxidation of metals or other chemical action was the only available method by which electricity could be produced, the expense attendant upon such means limited its use to a very narrow sphere. Since, however, steam power and water power have been so successfully employed to generate electricity, and to do it so cheaply, the range of its usefulness and application has been wonderfully enlarged from year to year. It is not intended in this paper to make use of scientific terms, or to discuss the question from any standpoint but that of practical observation and experience, nor is it intended that any comparisons shall be drawn between electric motors and steam locomotives, but there is a wide field for work in which neither the locomotive nor the horse is able to satisfactorily accomplish the duty called for.

The systems at present in use for electrical propulsion of cars are divided into two classes :

First, That in which the electricity is conducted from one or more active generating sources along a suitable conductor or conductors, to be used in the cars with proper return connections; and,

Secondly, That system in which the electrical power is obtained from accumulators or secondary batteries carried along with or within the body of the car. Of the first there are several methods, viz.: that in which the electricity is carried along a conductor above the ground, considerably above the car, either directly over it or toward one side; that in which the electrical conductor is situated at the side of the railroad and elevated a few feet only above the ground; that in which the electricity is carried upon the surface, either by a third rail or other conductor, running on the level of the ground or pavement; and that in which the electricity is carried beneath the surface by a conductor placed within a suitable conduit for its protection, access being had to said conductor through a slot in the top of the conduit, so as to allow of electrical connection with the motor on the car.

The plans of having the conductor along the surface or at the side of the railroad, not much above the surface, have so many evident and practical disadvantages that they need not be taken into consideration in this paper; therefore, the question is reduced to the three methods of overhead conduction, underground conduction, and storage batteries.

It is evident that better service must be furnished at the same cost, the same service furnished at a cheaper rate, or that both objects combined shall be attained by the use of electricity, before it takes the place claimed for it. The writer believes fully that the last proposition of both better and cheaper service has already been proved by actual service and daily use; but, in the nature of things, improvements upon the present method will be discovered, and "the survival of the fittest," which applies as well to mechanical appliances as to animated life, will by its inexorable laws weed out and discard those which are deficient or incompetent. There are so many intelligent, persevering and scientific minds engaged in active experiments and researches into the mysteries of nature's powers, and more especially those relating to electricity, that discoveries are constantly being made, human knowledge in this age extending more rapidly than at any previous time. The subject is fascinating and the prizes sought after are brilliant and valuable. The increased cheapness in production of electricity which may fairly be assumed for the future, will of course add to the advantages and enlarge the scope of its use. At present there are many places where electricity can be generated at a nominal cost by the use of water power, and this energy can be carried a number of miles without any loss or leakage of practical consequence. Where this can be done, of course the parties have special advantages. So also there are many towns and cities in coal regions, or natural gas regions, where the same result of cheapness in production can be obtained, although by different means. As a case in point, it may be mentioned that the electrical railway in Scranton, Pa., has its power station located about midway of the route, and immediately at the foot of a large hill or great mass of hundreds of thousands of tons of culm, which is principally composed of the small, fine particles of coal produced in mining, or left after the screening and preparation of the commercial sizes of coal for the market. This has been accumulating for many years, is still accumulating, and has hitherto been considered only an inevitable nuisance, which the mining proprietors would gladly have given away for nothing, to get rid of it, and not have it occupy their land. The price which the railroad company pays for this culm is but ten cents per ton, and as it only has to be wheeled through the door of the engine house, the whole distance from the culm hill to the furnace under the boilers not being over fifty feet, and as the whole consumption per day is on the average but five tons, or in money value but fifty cents per day, it is evident that the cost of electricity in this case is exceedingly small indeed, that sum being sufficient for the fuel to produce the steam power which generates electricity enough to run four and sometimes five cars, carrying at times seventy-five passengers each, over a railroad track about four and a half miles in length, having long grades, a number of which are five or six feet to the hundred, and the steepest of which is seven and a quarter feet per hundred. The tractive power required upon some of these grades is still further increased by curves or switches occurring upon them. It may be well to mention some other points about this railroad in Scranton, which has been running about one year, with great success, and exhibits in many respects a favorable example of an electrical railway with overhead conductors. The cars have four wheels; two of them are open cars, each carrying one motor of twenty horse power. The motor is placed in the body of the car midway of its length, and all four of the wheels are driving wheels, the connections between the motor and the wheel axles being made by means of chains and sprocket wheels. Three of the cars are closed cars, each with one motor of fifteen horse power, which is placed on a closed platform at the forward end of the car. In these the forward wheels only are driving wheels, and their connection with the motor is made in the same way as on the open cars, with chains and sprocket wheels. The company will shortly place four more cars upon the line, each with a motor of twenty-five horse power. These larger cars are intended not only to propel themselves but to be able each to haul in addition two other cars loaded with passengers up all the grades. The running time of the round trip on the main line, being in all eight miles, is one hour, which includes all stoppages and the waiting at each end of the route, so that the average speed attained is more than eight miles an hour. There is no difficulty in going much faster, in fact the men in control of the cars have to be watched to prevent their running at excessively high speed, particularly on the return trip to the city, where the grades allow the car to be run for the most of the distance by gravity alone. At the generating station there are two stationary engines of 180 horse power each, two dynamos of one hundred horse power each, and four boilers of one hundred horse power each Only one engine and dynamo, however, and two of the boilers are in use at one time. The railway company expects also to furnish in the future electricity for the lighting of the town of Dunmore, situated at one end of the line, by which the income of the company will be materially increased. The duplicate engine and dynamo and the duplicate set of two boilers, are for the purpose of providing against contingencies of accident to those in use, and also to allow of alternations in service, thus giving opportunities for frequent examination and inspection. Upon this railway, as before stated, the overhead system of conduction is employed, having flexible connection between the motor on the car and the carrier traversing the conductor, which is a solid copper wire of five-sixteenths inch diameter, suspended on a part of the route from transverse wires attached to wooden poles, placed on both sides of the street, about one hundred feet apart lineally, about twenty feet high, and about six inches in diameter at the surface of the ground; and on the rest of the line suspended from arms projecting sideways from wooden poles at the side of the railway, about twenty feet above the ground. The line is a single track railroad with several turnouts or passing places, at which points the electric overhead conductor branches off over the side track also, and an ingenious system is in use by which the carrier, running upon the overhead wire, with two grooved wheels of about two and a half inches diameter, automatically shifts the connections at the points of divergence from the main line, so that the carrier always follows that one of the overhead conductors which is above the track upon which the car is traveling. It is contemplated, however, to use two separate and independent overhead conducting wires throughout the whole length of the route, so as to avoid the possibility of any difficulty with the carriers at the points of intersection at the turnouts, although this has not happened often. The return current of electricity is taken by the rails. The electrical current has a tension of about six hundred volts, which, while sufficient to give a shock, could not produce any dangerous effect on man in case the current should by any means be diverted. Part of the road is laid with tram-rails and the rest with T-rails, and a part is paved and the rest unpaved, so that these different conditions, in connection with the many grades and the curves and turnouts, give ample opportunity to thoroughly test the working of the system. Although the overhead wires in this case do not present any more unsightly appearance than the numerous telegraph cables and wires to which we are so accustomed, it is, however, evident that the use of the overhead system will be prohibited in most cities and towns, especially since the general determination to place all electrical wires through cities underground. The noise of the carriers running on the conductors is not much, although it can be readily noticed, but the noise produced by the motors and the chain and sprocket connections, is quite considerable. This latter could be entirely avoided by the use of a noiseless motor and a better method of connection, of which motors and connections there are several kinds easily obtainable. Noiseless, efficient and durable electric motors, suitable for use on cars, can be had, in which the weight per horse power does not exceed sixty pounds.

In a paper of the length to which this must necessarily be limited, it will be impossible to do much more than treat of the subject in a general manner, but it can be stated specifically and certainly that electric railways with overhead conduction have demonstrated beyond a doubt their capability to propel a few cars, even if heavily loaded, at less cost and much greater speed than could be obtainable on railways operated by horse power. This is true in places where the coal required must be bought at usual rates, and the exceptional advantage of fuel at merely nominal cost does not exist as at Scranton, and likewise at Wilkesbarre, where an electrical railway is under construction, upon which the cost of coal used will not exceed sixty or seventy cents per day for five cars.

In the case of electrical railways with underground conduction, the effort has been made to give all the advantages of the overhead system, and at the same time remove the objection, which in most places is absolutely prohibitive, of having the conductors and poles or other supports obstructing the streets. In doing this, however, great difficulties arise, some of them of a very serious character. The costly conduit, with the needful arrangements for drainage and for cleaning out, together with the increased care necessary to provide against the considerable loss or leakage of electricity, which, nevertheless, generally takes place in spite of all precautions, detract greatly from the apparent advantages of the plan. Many inventions have been patented, and numberless devices contrived, to overcome the many objections to this method, but there is great room for doubt, whether practical success has yet been obtained.

Neither by overhead nor underground conduction have more than a few cars as yet been moved simultaneously upon railways although many ingenious arrangements are offered by various parties who confidently assert that they can run any required number of cars. This, however, yet remains to be proved. Both plans also are open to another serious objection in the entire stoppage of travel on the whole line in case of breakage or derangement of any part of the conducting apparatus or the generating machinery. In this respect they are under the same disability that the cable system of car traction is hampered with. Possibly by suitable arrangements of duplicate engines, boilers and dynamos, duplicate conductors, and auxiliary, sectional or relay systems of conduction, this disability, threatening as it appears to be, may be so reduced as to be of no great detriment. This, however, also remains to be demonstrated. Taken altogether, underground conduction does not compare favorably with overhead conduction up to this time. One great trouble with the latter plan, however, is that although it can be used to great advantage and economy on lines running a few cars in towns, or in suburban districts, outlying large cities, it will probably never be allowed by the municipal authorities in large cities, which of course are the very places where the advantages of electrical propulsion are needed the most. To move a large number of cars, as for instance upon the Third Avenue or Broadway lines in New York City, the electrical conductor, whether overhead or underground, must be of great size, if the current is of low tension; while on the other hand, if a small or moderate sized conductor be used, the current must then be of dangerously high tension, and of course, it would then be very difficult to avoid great loss of electricity from leakage.

There remains to be considered the accumulator or secondary battery system. In this each car carries its own supply of energy, and is entirely independent of any method of continuous electrical conduction. No change of track or roadway is required, nor any costly conduit or unsightly poles or other supports, while the cars can run anywhere that a battery car can be taken by horses. These points are of immense advantage and are the chief merits advanced by its advocates, independent of its economy over horse power.

In practice, cars of the size of the usual two horse cars are provided with about 80 accumulators, weighing, when filled with fluid and ready for use, about 40 pounds each. These cells are placed under the seats, one half being on each side of the car. Their combined weight is 3,200 pounds, and the weight of two motors each of five horse power should not, together with their connections to the car axles exceed 800 pounds, so that the additional weight imposed upon the car is, say 4,200 pounds, which allows 200 pounds for the apparatus to control the current and for other electrical appliances. This added weight if placed upon a four-wheeled car may be of disadvantage to the car or to the track. If this should be the case, the difficulty is removed by the use of eight wheels on two swinging trucks, which support the car much better, and distribute the weight upon the track. Both these kinds of storage battery cars are in service with entire success. The charging of the cells is done by a dynamo driven by steam power or any other desirable means, and it takes four hours to charge cells which are able to perform four hours work. To remove from the car the cells which have done their work, and to replace them by freshly charged cells, takes no more time than the time required to change horses. It requires 10 horse power exerted for four hours to charge the batteries or cells of each car, so tha 40 horse power hours are needed to accomplish it.

The cost of running large stationary steam engines, of say 200 to 400 horse power constructed with the modern improved cut-off appliances and other economical devices, has been found, after extensive investigations, not to exceed two-thirds of one cent. per horse power hour. This allowance is a liberal one and is above rather than below the actual average cost, including fuel at average market prices, attendence, repairs to engines and boilers, oil, etc. We will, however, take it at one cent per horse power hour: 40 horse

power hours, at 1 cent cost 40 cents, which is the cost of four hours car service, and as the day's work of a car should be taken as 16 hours, we have as the whole cost of a day's supply of electricity four times 40 cents or $1.60. Since four teams of horses are required to draw a car for 16 hours, and as one additional horse per car is the usual allowance for sick or disabled horses, nine horses per car are needed for a day's work, which at 50 cents per horse for feed, bedding, attendance, shoeing, etc., is $4.50 as against $1.60 for the storage battery electricity. Making extraordinary allowance for possible errors in this comparison, the difference is still astonishing to those who have not looked into the matter critically. With motors properly constructed a speed of eight or nine miles per is readily accomplished, in fact eight miles an hour may be taken as the speed at which such motors will work to the best advantage and return the greatest percentage of mechanical efficiency. The requirements of street car service demand variable rates of speed, as for instance in crowded streets, behind other vehicles, or in turning curves and entering switches, it is necessary to go slowly and cautiously; and the weight of the load carried at different times will vary from an almost empty car to one overloaded. These conditions, together with increase power needed to ascend grades, and to start loaded cars, especially on up grades, call for electric motors, which will, under such greatly varying circumstances, respond at all times almost equally well.

There are motors which while engaged in performing an equable work and running at an equable speed, for both of which purposes the motor was specially made, will return 90 or possibly 95 per cent. efficiency, while the same motor when run at some different speed or under some different load may return but 30 or 35 per cent. So that the average performance of such motors in street car service would probably give only 50 per cent. return of efficiency. Motors can, however, be obtained which will under all the variations of street car work constantly return 75 per cent. of efficiency.

The durability of storage batteries is a point which those interested in other systems are very prone to doubt, but it has been proved in actual use in cars that they will continue in good good serviceable condition for eighteen months or two years. Makers of these batteries offer to guarantee them good for two years of street car service. The lead lined wooden containing boxes will last for many years; the negative plates are good for more than two years; while the positive plates are certainly good for eighteen months if not more. The plates being of lead and lead oxide are still of value when they become unserviceable, for the metal can be re-cast into new plates, and the lead can be recovered from the oxide. The first cost of storage battery cars and the engine and dynamos is at present prices considerably more than the first cost of cars provided with suitable complement of horses and harness, but when the saving in first cost obtained by dispensing with the ground and the stables required for horses is taken into account, the balance will in many cases, be in favor of storage battery cars. This is, of course, applicable more particularly to large cities where ground is very valuable. By methods now being introduced into the manufacture of storage batteries, their production will shortly be made at a reduced cost, and their durability increased at the same time.

It should be remembered that the increased speed at which electric cars can travel is so much greater than horses could draw them, that two cars can readily do the work of three horse cars, especially as the electric cars require no time for resting at the ends of the route; but although they can readily do this, so much increase of speed would not be allowed or be practicable through the streets of most cities or towns. It could be done with safety and advantage through wide streets or avenues and in suburban districts. It will, however, be perfectly safe to say that three electric cars can do the work of four horse cars, and if desired they can at the same time be of greater capacity than horse cars, for while the horses can do no more, no such difficulty exists with electricity. Without referring to the excessive first cost required for the expensive cable traction system, and comparing the first cost of the entire plant and equipment needed for a storage battery electric railway, on which three cars will perform the service of four horse cars, with the first cost of the entire plant and equipment of a railway, using horse power, it will be found that the advantage will in most cases be in favor of storage electricity.

Let us now compare the operating expenses.

Running expenses of 4 two-horse cars for one year, to wit:

Conductors, 365 days, at $3 each car per day of 16 hours	$ 4,380.00
Drivers, 365 days, at $2.50 each car per day of 16 hours	3,650.00
36 horses, 365 days, at 50 cents each per day	6,570.00
	$14,600.00
One year's deterioration and repair of 4 cars at $200	800.00
One year's deterioration of 36 horses at $40 each	1,440.00
Total	$16,840.00

Running expenses of 3 storage battery cars for one year, to wit:

Conductors, 365 days, at $3 each car, per day of 16 hours	$ 3,285 00
Drivers, 365 days, at $2.50 each car, per day of 16 hours	2,737.50
Electricity, 365 days, at $2.00 each car, per day of 16 hours	2,190.00
	8,212 50
One year's deterioration and repairs of 3 cars, including dynamos, storage batteries and motors, $1,600 each	4,800.00
Total	$13,012.50
This leaves a balance to the credit of the storage battery cars of	$ 3,827.50

The fact of each storage battery car carrying within itself its own energy gives to the individual cars an independence of action which neither the cable traction plan nor the overhead or underground system of electric propulsion possesses, for all of these depend upon central sources of power, which may at any time be interrupted, so that breakage or accident, to any part, involves the stoppage of the whole line. In a sanitary or cleanly point of view, the withdrawal of the car horses from our streets would be of great benefit, and this would be accomplished without having, as in the case of the cable railway, an open drain, which, although supposed to be kept clean, in fact, nearly always contains deposit of street refuse to a greater or less extent.

The leakage of electricity in storage batteries, charged but not in use, need not be taken into account for any length of time that cars would probably stand idle. In fact, the leakage from batteries in good condition would not exceed ten per cent. in three months.

The percentage of mechanical energy given by the steam engine which is recovered in actual work under the variable conditions of street car service on the driving axles, with storage battery cars properly equipped, is at least forty per cent., and with electricity by direct conduction at least fifty per cent. In cable traction, after deducting the power needed to move the cable and to revolve the wheels guiding and carrying the cable, not over twenty-five per cent. is left for drawing the cars, and on some cable railways even less.

The increased speed so easily and advantageously obtained on electric railways, as a class, not only enables three cars to do the work of at least four horse cars, and effect the great annual saving shown above, but it has a tendency to invite travel and thereby increase receipts, also to give street railways the opportunity to extend their lines advantageously further into outlying districts, and to compete on better terms with elevated roads and steam railroads than would be possible with horse power.

The rapid deterioration and destruction of street car horses shows the exacting and terrible nature of their work, although it is only for four hours per day. Their powers are already overtaxed, and they can do nothing more in either speed or in load carried.

Electric cars, by dispensing with horses, allow more room in the streets for other vehicles, and this advantage in crowded streets is of moment. Take, for instance, Washington street, Boston, or Broadway, New York, and it will be readily seen that this relief to the clogged traffic would be great. Electric cars can go backward or forward with equal facility; they are under perfect control, can stop and start more quickly than horse cars, and in case of delay can make up lost time. They never get sick with epizooty or other disease, and during strikes or other periods of enforced idleness, do not require to be fed. On down grades they will run by gravity without the expenditure of other force, and on level or nearly level stretches, a very little electric energy continues them in motion when once they are started. The electricity, besides running the motors, will supply the cars with incandescent electric lights, actuate an electric signal gong, and operate electric bells for the use of the conductor and passengers in stopping or starting the car. It is usual to have the regular hand brake for stopping the cars, but the motors can be instantly reversed by electricity, if desired. This method, however, should only be employed when it is necessary to stop the car quickly to avoid accident or for some other imperative reason. By this means the car can be stopped in much less distance than is possible by the hand brake, which, of course, operates with the same efficiency, whether upon electric cars or horse cars.

It has been questioned whether in winter when the tracks are liable to be obstructed with snow or ice the electric cars will be able to propel themselves, owing to the fact that they obtain their power of propulsion from the adhesion of the wheels upon the rails, so that if the wheels are prevented from reaching the track there would be a great liability of their slipping and turning around without giving any forward motion to the car itself. In answer to this, it may be stated that during last winter, on the electric railway in Scranton, having the overhead conduction system, and from experiments made in Philadelphia with a storage battery car, it was found that there was no unusual difficulty presented in snow storms, the wheels, owing to the added weight, settling more readily through the snow and thus reaching the rails. Upon roads properly equipped with snow plows, or snow sweepers with revolving brushes, propelled by powerful electric motors, the clearing of snow from the tracks would no doubt be much more efficient than horse power could effect. Street car electric motors of 50 horse power, or more, if required, can be as easily made and one as easily controlled as motors of five and ten horse power, so that electricity has ample ability to keep the tracks clear from accumulation of snow. As with locomotives, sand boxes should be placed upon electric cars, so that if any slipping of the wheels should be observed, either from the greasy, slippery condition of the crack, sometimes seen in damp weather when the streets are not properly cleaned, or from snow or ice upon the track, the driver, by opening a suitable valve, can let out a little sand upon the rail and at once overcome the difficulty. It is sometimes asked why two motors of five horse power each should be needed upon a car usually drawn by two horses. In explanation of this, it may be stated that a car horse can, and very often does, exert for a short time, in starting a car or upon steep grades, a force of five or even more horse power. A mechanical horse power is the measure of the moderate duty which a horse can constantly and regularly exert day after day in a regular day's work without injury, but car horses are constantly temporarily called upon to exert unusual and unreasonable power, which is the reason they are so rapidly destroyed in street car service. It is evident, therefore that the electric motors must be able, when called upon, to exert the same power that the horses under pressure can be made to perform temporarily, so that the maximum of five horse power in each of the two motors will develop only such force as the requirements of street car service are constantly demanding during short periods of time.

It is not intended in this report to indicate that cable railways for use on steep hills or high grades will be superseded by electric railways, for the latter are limited to such grades as the adhesion of their wheels upon the rails will enable them to surmount, just as in the case of the steam locomotive, so that there is a suitable and proper sphere of usefulness for cable railways in the many places for which they are particularly adapted.

It has been proposed to increase the tractive power of electric cars upon inclines by causing magnetic attraction to be developed between the wheels and the rails, and also by the use of other devices. All these methods present complications which probably will more than outweigh the advantages sought to be attained. In developing the best construction and management of electric cars and railways, careful attention to details, some of which at first sight may appear trivial, should be exercised, in order to obtain the best results, no matter which of the three plans be adopted. It should, however, be said that in practice at the present time, the running of electric cars requires no more intelligence or skill than running of horse cars, and also that the electric current, with continuous conjuction on lines using a few cars, need not be of such tension as to endanger human life, 500 volts being sufficient. With the storage battery system the tension of the current is so low, 160 volts being sufficient, that no shock whatever could be experienced by a man taking through his body the whole current required to propel the car. This has been repeatedly done, some of the people stating they felt nothing at all, and the others no more than a slight tingling sensation.

The term "storage batteries," so generally in use, is apt to give a wrong impression, no electricity whatever being stored or contained within them, for in charging the batteries a chemical action is forced to take place, and when this chemical action is allowed to reverse itself, electricity is generated thereby. The car motor immediately uses this, and when the motor is stopped, the chemical action and therefore the generation of electricity ceases.

In this report, care has been taken not to refer by name to any patented inventions, or to recommend any particular make of electrical appliances. As to those matters, those proposing to use electricity, whether by overhead or underground conduction or by storage batteries, should of course be careful to select such methods as are the most reliable, efficient and durable, and to deal with parties not only responsible as to the validity of their patent, but capable of doing what they undertake to perform. Any one who puruses the railway journals and notices the number of electric railways now in operation, and the still greater number of those in course of actual construction or projected, has cause for surprise if he has not been closely following the course of events. That electricity, by some of the present methods of its use, or by better ones yet to be invented, will entirely supersede the use of horses and cable traction upon all street railways, excepting under the special conditions for which cable traction is occasionally applicable, is a question that admits of very little doubt.

R. Dudley Frayser, of Memphis, inquired as to the figures of the additional weight imposed on a car by the use of the motor.

Mr. Wharton replied that the total of the extra weight was 4,200 lbs., viz.: storage batteries, 3,200 lbs.; for the two motors and their connections with the axles, 800 lbs.; for the apparatus to control the current and for other electrical appliances, 200 lbs.

Albert G. Clark, of Cincinnati, inquired as to the amount allowed for deterioration in the item of "operating expenses."

Mr. Wharton explained that the allowance was for the deterioration of the storage batteries, the dynamos and of the itself; and he had fixed the amount at $200 per year, as in the case of horse cars. He had endeavored to be accurate, but was inclined to think he had been too liberal in this, as in other instances. In other words, he believed that he had over-stated the amount of deterioration. He could not divide it up and tell just how much belonged to the battery, how much to the motor, and how much to each particular wheel of the whole appliance, but, according to his best judgment, the total was within the amount stated.

Winfield Smith, of Milwaukee, called attention to the difference in the price of coal between that sold in the part of the country from which he came and that sold in Philadelphia. He desired to know the assumed price of coal to be used for the generation of electricity.

Mr. Wharton said that his own assumption of the cost was based upon the average price of various localities. He suggested that the cost could be estimated by taking the average of prices in Philadelphia, New York and Boston, and that, for coal of the character required, this certainly need not exceed $3 per ton.

Albert G. Clark, of Cincinnati, remarked that, in his investigation on the subject, he had failed to find that any practical underground system had been as yet established. In Montgomery, Ala., fourteen miles of road, on which ten cars are run, are being operated on the over-head system. This plant is worked by two 75 horse power engines, which are capable of being increased to 100 horse power; and there they use, in operating, one and one half tons of coal per day. In Lima, Ohio, five cars are being operated with the expenditure of seven barrels of oil per day, at 30 cents per barrel. According to the information given him, oil at 68½ cents per barrel was equivalent to coal at about $2.50 per ton. In Mansfield, Ohio, a road is being operated by electricity. Both in Mansfield and Montgomery, there is an eight per cent. grade.

Mr. Moss, of Sandusky, Ohio, inquired as to Mr. Wharton's preference for motors of five horse power each, instead of ten horse power.

Mr. Wharton replied that, in his opinion, the two motors of less power afforded better opportunities of combination in adjusting the current and in manipulating its strength.

On the other hand, double labor was involved in keeping two machines in order and the liability to break down was also doubled. As an offset to that, however, there was the counter consideration that, if one machine broke down, the other could be availed of to keep the road in operation. With two motors in use, each can be applied to an axle of the car and thus all four of the wheels can be made driving wheels. With but one motor, only the two wheels on the same axle can be made driving wheels. Certain advantages are to be gained on either plan. The question is one which can only be answered by careful study and actual experience.

Mr. Moss, of Sandusky, said he had heard with surprise the statement of the report that the batteries had been stored in four hours, because only on the previous day, in New York city, the statement had been made in his hearing that thirteen hours had been consumed in the storing of what he understood to be fifteen horse power batteries.

Mr. Wharton answered by reiterating the assertion made in his paper that he had not consumed more than four hours in storing his batteries. He again declared that this period was abundantly ample.

Calvin A. Richards, of Boston, commented upon the persistency with which the author of the report had been interrogated upon its details and deprecated what he regard as a carping criticism of a paper which, in his judgment, was the most exhaustive on the subject which could have been rendered. He contended that the mere fact of the utilization of that unknown power, electricity, for purposes of transportation was something which was entitled to be received with joyful acclamations by all present. It was perhaps well known in the convention that he (Mr. Richards) had been one of the most earnest, as he was one of the earliest, advocates of the system under consideration. He was delighted and gratified with what Mr. Wharton had accomplished, and, in the light of the fact that much yet remained to be done, it seemed proper for the convention to pause at this point and take an observation upon the point they had reached in this great field. For one, he did propose to inquire critically into the whys and wherefores of it; it was sufficient for him to know that the essayist had given a demonstration of the practicability of propelling street cars by this new medium, at a cost much less than that of animal power. There was in this, he thought, sufficient cause for jubilation and mutual congratulation.

Charles Cleminshaw, of Troy, N. Y., explained that the inquiries propounded to Mr. Wharton had not been inspired in any spirit of criticism as had been intimated by Mr. Richards, but to acquire information.

Mr. Wharton, in reply to Mr. McCreery, of Pittsburgh, stated that arrangements would be made by which the members of the convention would be enabled to examine the motor car and its plant on this (Wednesday) evening, and also on the following evening. He proposed to show them a car which would surmount a six per cent grade. He had himself traveled on a railroad in Scranton, Pa., on which a grade of 7¼ feet to the hundred was surmounted with perfect ease; and he had been told of a railroad in Pittsburgh on which the motor ascended a grade of 12½ feet to the hundred.

Informally replying to an inquiry by Winfield Smith, of Milwaukee, as to the merits of the steam motor in comparison to electricity. Mr. Wharton stated that there are many localities in which the use of steam on the streets is prohibited, and that the cost of steam when used in portable engines is relatively greater than that of electricity as applied to portable engines.

Upon the re-assembling of the convention in the afternoon, on motion of Mr. Powers, of Boston, the pending order of business was informally deferred to permit F. J. Sprague, of the Sprague Electric Railway & Motor Company, to submit some remarks suggested by the discussion on "Electricity as a Motive Power."

Mr. Sprague said that, of the three general systems applicable to street railways, viz.: the overhead wire, the conduit, and the storage battery, the first is the cheapest and the one most frequently in operation. The conduit system would doubtless be used, in some cases, where the number of cars in operation is large and the return proportionate to the investment. The storage battery system will be used where there are only a few cars and these are running under long headways. It requires a liberal outlay of capital because it must stand the same strain and conditions of weather and traffic which a cable conduit must stand, and, in addition, must provide ample protection for the conductors on which the operation of the whole system depends. Such an investment can not be made where cars are run at long intervals, because the traffic receipts would not pay a sufficiently remunerative dividend. The storage battery system offers the advantage over the others of perfect independence of action, but it has this disadvantage, that the capacity of the battery is limited, while the weight of it is objectionable and its depreciation not easily ascertained. Storage battery companies are in the habit of guaranteeing their batteries for two years upon the condition that not more than a certain capacity is required of them. It is quite possible to develop, with a good battery of not over 3,800 pounds in weight, fifteen horse power with a net efficiency of about 78 or 80 per cent.

The question of traction, upon which objection has been made by some street railway men, seems to have been met. We have had, said Mr. Sprague, a car, driven with only one pair of wheels, surmount a six per cent grade. This may be considered to have been done under exceptional conditions of track, but it was done on a very sharp curve. If both axles are driven independently—the one not being dependent on the other—there is no question that a six per cent grade can, under all circumstances, be taken.

In the adoption of any system or method of operating cars by electricity, the question of the number of cars operated is a most serious one. If operating one or two cars over five or six miles, it were better to dispense with electricity. When operating three or four cars, the question of headway is an important one, unless the power is derived from some existing station, or under exceedingly economical conditions. A certain number of cars, under given conditions of station operation, must be operated under any of the systems before any economy, as compared with the horse traffic, can be attained. The greater the number of cars, of course the more apparent that economy will be.

THE VAN DEPOELE ELECTRIC RAILWAY SYSTEM.

Charles J. Van Depoele, of the Van Depoele Electric Manufacturing company, Chicago, upon the suggestion of Mr. Lewis, of Brooklyn, was invited to discuss the system with which he is identified. Mr. Van Depoele, upon coming forward, said he would state merely a few facts in regard to electric railways and their practical operation at present with respect to the cost of running. He thought it would be superfluous to discuss their general practicability. He said that for the last three or four years the Van Depoele company had expended large sums of money, and had run electric railways with success.

In some instance slight imperfections had been shown, but these occurred not in the electrical parts, but in the mechanical parts. It could be said to-day that the condition of the electric street railway, when ready for the market, was as good as the condition of any ordinary steam engine could be, and that, as a means of propelling street cars, it had come to stay. He then read statistics showing the daily cost of running the roads now being operated under this system. He explained that, where the cost of coal did not exceed $4 per ton, his company could contract to run an electric road for $2 per day of eighteen hours. He surmised that the actual cost might not exceed $1.75 per day. The road could be run at any speed that would be permitted by local authorities. Upon the road in Scranton, Pa., an average speed was maintained of about fifteen miles an hour.

The overhead wire system could be established in small towns for about $1,000 per mile, whereas the cost of an underground conduit would be from $5,000 to $10,000 per mile. A practically good conduit could be made for about $6,000 per mile. He thought that, in any combination which might be formed between the conduit system and the overhead wires, arrangement could be made by which the cost of the plants would be kept at a reasonably low figure.

Mr. Lewis inquired as to the cost of maintaining the motor in use. Mr. Van Depoele replied that the depreciation of the electric motors, so far as statistics showed, would be about two per cent. per annum. Ordinary machinery running in a shop depreciates at the rate of from two to five per cent. per annum. The wear would be rather upon the running gear than upon the motors.

MR. VAN DEPOELE, in reply to inquiries by Messrs. Littell, Clegg, Cronyn and others, made the following additional statements: The company has not now in operation a combination of the overhead and conduit systems, but is constructing such a system in Dayton, Ohio. The connection between them would be worked automatically. As soon as the electric railway demonstrates its practicability to the satisfaction of the public, there will be no hesitation in constructing underground conduits nor any doubt about their success. Electricians can practically insulate an underground conduit as effectively as they can insulate in the overhead system, and even more effectively, because they have a better chance of getting at their work and can construct it in a more solid and substantial manner. In 1884, the speaker said, he put up a small road in Ontario, Canada, on which he used an electric pressure which is five times higher than the ordinary pressure, and this road has been running since that time without any trouble in insulation or otherwise. It was originally intended merely as a kind of exhibition road.

The conduit proper is to be placed nine inches above the cross tie; that is, from the top of the slot in the conduit to the top of the tie. With the Johnson rail or with the wooden stringer, there will be a slight slope of 1½ or 2 inches toward the rails, which will prevent water from readily entering the slot and will also exclude stones and sand. The movement of watches is affected by their proximity to an electric machine. This had been remedied in the case of a machine at Scranton by stationing a shield in front of the electric motor. The use of electric machines, however, was not likely to be abandoned because their presence might subject the owners of time-pieces to inconvenience.

Concerning the effect where the conduit becomes filled with water, Mr. Van Depoele stated that, in making an underground conduit, it was necessary to have regard for insulation. The water must be kept out of the conduit, and provision could be made for this. Outlets could be provided. In the absence of a sewerage system, catch basins could be supplied and these could be cemented so as to prevent water from coming in from outside sources, and the gutter could be arranged in such a way as to carry the water along the length of the road. In that way the ground would not, except after long periods, be likely to become so saturated with water as to cause an interference with the conductors. It could be easily arranged to keep the conductors perfectly dry and to keep up the insulation.

With respect to heavy grades, a trial had been made at Appleton, Wis., where there was a ten per cent. grade and a curve of 60 feet. A 15 horse power motor and a 12 feet car were used there. No difficulty was encountered in ascending the grade, although in the winter time, with snow and ice on the track, the ascent would be difficult. Practically the company had been running on seven and eight per cent. grades, through making use of a sand box. At Scranton, Pa., they ran on seven and eight per cent. grades and around curves without trouble. They anticipated no difficulty from grades of eight or nine per cent. Those of ten per cent. would be a little harder. New methods of traction which would afford the requisite relief might be arranged. No difficulty was apprehended from over-heating in ascending hills, as the motor could be made large enough to meet requirements.

Mr. Van Depoele also stated that he preferred using one, instead of two motors, as a single motor could be placed where it would be most likely to be taken care of, that is, near the driver. Concerning the gearing, it had been found sufficient to connect only the front wheels. Where heavy grades are to be ascended, the back axle was also connected.

Wherever a telephone or telegraph wire falls on the conductor overhead, it may be safely assumed that there is general havoc in the telephone or telegraph office. [Laughter.] The electric motor does not experience any sensation from the contact except that, for the time, the line is a little short circuited. To prevent this, a guard-wire is placed over the main wire, where the overhead system is used.

Mr. Woodworth of Rochester, inquired as to the objection on account of the noise, and the consequences of this in frightening horses on streets or roads.

Mr. Van Depoele replied that the noise need not be other than that of the ordinary street car. Ordinarily common bearing had been used; and this, being of steel and iron, has not only made a good deal of rattle and noise but disgusted many with the electric railroad as it was run in the beginning. By using proper gearing [raw hide is now used for the pinion upon a clear cut larger car wheel], the Spofford chains do not make any noise. By replacing of the steel pinion with a raw hide the noise is entirely eliminated. Besides that, the gearing is entirely encased in a box, and this suppresses the noise. These matters are mechanical details which have been productive of troubles, but as to which the causes of complaint have been removed.

The trouble which had been anticipated from accumulations of sleet and ice in winter storms, in breaking the connection on the main conductor has not arisen. On one occasion, in Scranton, Pa., ice had accumulated on the conductor to a thickness of half an inch. The speaker described the passage of the car and the breaking of the icicles, which he observed at the time; his observation assuring him that the current naturally has a pressure sufficient to enable it to go through the ice when this is not too thick.

E. J. Bagney, of St. Louis, inquired as to the size of the wire for running twenty-five cars on a double track.

Mr. Van Depoele replied that he would use three-eighths copper wire on each track, and would connect the two wires so as to get the combined activity of both conductors. The size of the wire would depend entirely on the number of cars used and the motive power required to do the work.

To avoid a collision, or for any other reason, a car may be stopped within a distance of about the length of the car. Of course this would depend largely on the track and the rate of speed. An actual stoppage can be made within about the length of the car. A car can be run backward and forward with the same case.

Winfield Smith, of Milwaukee: Where I live, overhead wires would not be allowed. The practicability of the conduit on the ordinary rough streets of a city seems to me to be in doubt, especially where pools of water or melted snow are to be found. I ask Mr. Van Depoele to say which he considers to be the most practicable method of running cars under such circumstances—whether by independent motors, by storage batteries, or by conduit?

Mr. Van Depoele: We would have to consider, as a business question, the comparative economy in the cost of running as between the storage battery and the conduit systems. The question is solely one of dollars and cents, and the cheaper method is the one that should be adopted

CORRESPONDENCE.

Eastern Electrical Comment.

NEW YORK, Oct. 22.—The absorption of the Baltimore & Ohio by the Western Union Telegraph company has been quickly followed by the abolition of the ten and fifteen cent rates which have finally led up to the inevitable result of an effort to maintain an extensive telegraph system on a fictitious basis. It could scarcely be expected that the Western Union management would retain this ruinous tariff, but according to the editorial writers of the New York press, who assume to know everything about the management of other people's business, this was the proper thing to have done.

Preparations for accomodating the new accession of wires are being made at 195 Broadway. A local wire between the two offices was the first connecting link established, and one of the B. & O. main wires was also run into the Western Union operating room. A 50-wire section is being added to the switch-board, and when this is in position the transfer of wires will doubtless follow immediately. According to the estimate of Dr. Green, the B. & O. was handling about one-seventh of the business carried by Western Union. This will probably raise the daily average of messages in the New York office to upwards of 100,000. A large proportion of the opposition patrons will resort to the Postal company, while at the newly established rates less telegraphing will be done. The best operators will be retained in the service, but the "waiting list" will doubtless be considerably increased.

The prospective opening for American telegraphers at large salaries in the Chinese service seems

to have been suddenly stricken with a blight. There has been considerable prevarication in the newspapers regarding the imperial concession to Count Mitkiewicz, but there is little doubt that the bottom has fallen out of the affair. Frank Rae, who returned from China in the count's retinue, has gone to Chicago to take charge of the Gold & Stock ticker service. He has had valuable experience in that branch of telegraphing, having been associated with Stephen D. Field in the organization of the Commercial Telegram quotation service in this city.

The Gibbens-Hewitt combination continues to be the leading attraction at the meetings of the Board of Electrical Control. Mayor Hewitt has evidently absorbed all of the arguments which were so fruitlessly hurled at the "underground" law pending its passage. He assumes to be the guardian of the public welfare, and insists that poles and wires are decidedly less of an evil than the continual upheaval of the pavements by Contractor Crimmins' sappers and miners. If Commissioner Gibbens and his colleagues desire to continue in office, the mayor is certainly doing what he can to perpetuate the work. There is a grain of truth in his assertion, that there is a possibility that the work may have to be done over again. Commissioner Gibbens endeavored to obtain permission for the electric light companies to erect iron poles, but the mayor thinks wooden poles are safer, and the application was tabled. The mayor conscientiously votes "no" to all propositions to extend the subway work, but he is in a hopeless minority. He moved that an editorial in the *Times* of October 20th be spread upon the minutes, which, being amended by Commissioner Gibbens to include the whole paper, brought the whole measure to ignominious defeat. The sparring match ended by the mayor's remarking that there were a great many things which Mr. Gibbens did not know, the latter promptly retort that "there are some people who don't want to learn anything either."

According to a press dispatch from New Orleans the "underwriter's" wire got in its work to such an extent during a recent heavy rainfall that the insurance authorities should be convinced of their error in permitting its continued use. Nearly five inches of rain fell on the 18th and 19th. Hundreds of trees were blown down and many houses unroofed. The electric light wires were torn from their fastenings and falling upon the roofs of buildings, the current escaping through the soaked fireproof braid set on fire five buildings in different parts of the city. If thorough investigation confirms this report, the question of insulation will doubtless be taken up immediately, for such a striking instance of the dangers arising from this class of electrical installation should not pass by unnoticed.

Professor George Forbes has been suddenly recalled to England and will sail on Wednesday, October 26th. He has been very successful in bringing the attention of the public to his couloumb meter. The *Sun* of October 16th published a column descriptive of the instrument, illustrated by a cut copied from the WESTERN ELECTRICIAN. Professor Forbes was a guest of President H. C. Davis at the Electric club Thursday evening, and listened to the conundrum propounded by Professor Waldo of Yale—"What is an electrician?" It was rather a curious commentary on the "state of the art," that no one appeared to be able to give a satisfactory answer to the question. P.

New York Notes.

NEW YORK, Oct. 22.—The assembly telephone investigating committee has been making an inquiry into the affairs and business methods of the Buffalo company, which controls western New York, including Rochester. But two complaints were made by citizens, both against the toll system. Secretary H. C. Palmer told how the stock had been watered. The company was formed in 1879, with a capital stock of $30,000, all taken by Buffalo parties. In December of the same year the capital stock was increased to $300,000. Of this, $140,000 was paid for in cash and the remainder was distributed pro rata among the stockholders. In June, 1883, the stock was increased to $600,000. Of this extra amount $210,000 went to the parent company of Boston to pay for the franchise, $56,840 worth of stock was retained by the company as treasury stock, and subsequently sold at par to the stockholders to raise money for extensions, and the remainder was distributed to the stockholders as a stock dividend. The Bell Telephone company of Boston, now own only five shares less than 50 per cent. of the capital stock of the Buffalo company. All their holdings in excess of $210,000 given for the franchise were paid for in cash by that company. The entire number of stockholders is 62. A table was submitted showing the gross earnings and expenses since 1880. The expenses were $919,017.20, and the earnings $1,210,487.63. It was stated that the cost of the plant in Rochester was about $100,000, and the Buffalo plant was worth $200,000. The depreciation amounted to about 20 per cent. per annum. The cost of putting the wires under ground in Buffalo would be about $50,000 per mile for the four miles proposed to be put under ground. This estimate was to fill the conduits with wires suitable for the present number of subscribers. The committee adjourned until November 10th to meet in New York.

The French Atlantic Cable company has issued a notice to the public requesting that all cablegrams intended for transmission by its line be handed to the Postal Telegraph Cable company.

The Western Union's monopoly of cable business to the West Indies promises to be soon ended by the laying of new lines by the Commercial and French Cable companies, acting together. The French government has granted a concession to the French company for a cable connecting Brazil, Central America, the Antilles, and New York, and 15,000,000 francs are reported to have been subscribed for it by a syndicate including Credit Foncier, the Comptoir d'Escompte, and the Transatlantic bank. Work on the new lines is to be begun immediately. A land line will connect New York and Charleston, from which city a cable will be laid to Havana. From Havana another will go to Hayti or San Domingo, thence to Guadeloupe or Martinique, and thence to French Guiana, where connection will be made with the Brazilian land lines for Rio, Pernambuco and other South American points. A short cable will be laid between San Domingo and Jamaica, connecting with the system now existing in Central America and along the western coast of South America. The new lines will at once come into rivalry with the Western Union in the West Indies, where that company has had things pretty much its own way for the last fifteen years. They will also cause a considerable cut in the rates to Rio, now reached by cables by England and Spain.

The annual convention of the American Street Railway association met this week in Philadelphia. The most important subject considered was the use of electric motors. William Wharton, jr., exhibited cars in operation operated by storage cells under the seats, and others operated by connection with an overhead conductor. President Lewis and Secretary Thompson, of the Brooklyn City company, attended the convention for the purpose of examining these cars. The Brooklyn City company are considering the question of replacing horses with some other motive force, and already have obtained consent from property owners along the line to use electricity on Fulton street and Flatbush avenue from the ferry to the city line. Mr. Thompson, speaking of the proposed change, says: "We are ready to adopt some system and immediately put it into operation as soon as it is a proved success, but we are too big a corporation to afford to make a mistake.

A novel boat is being built in Montreal. It is a steam launch, with two cigar-shaped hulls with a deck binding the two together. The boat is intended for whale, walrus and seal hunting in the Arctic, and will be furnished with a Gatling gun, as well as a powerful electric battery, sufficiently strong to paralyze aquatic mammals.

Judge Pratt has granted the injunction against the city of Brooklyn asked for by the commissioners of the electrical subways restraining the city from interfering with the New York and New Jersey Telephone company in the work of conduit laying and making connections therewith. Judge Pratt granted the injunction on the ground that the resolution of the common council, passed last December, requiring telegraph and telephone companies to apply to that body for permits to lay down electrical subways, was a violation of the law under which the subway commisioners acted, and which placed the former in their hands. The little scheme of the aldermen to make the telephone company come to them for a permit is consequently a failure.

At a meeting of the executive committee of the Western Union Telegraph company this week, the following resolutions were adopted: "*Resolved*, That no advance in rates heretofore charged by this company be made, except in cases of the ten and fifteen cent rates between points where the handling of business at these rates has made an absolute loss: and be it further *Resolved*, That the officers of the company be empowered and directed to reduce the rates now charged wherever in their judgment such reductions should be made." The meaning of these resolutions, according to Dr. Norvin Green, is that business done at a loss while the Baltimore & Ohio was a competitor, will no longer be done on such a basis, while business which has paid the Western Union a fair return will not be compelled to pay an increased rate. The operators employed by the Baltimore & Ohio are in a gloomy frame of mind. They believe their services will be dispensed with on November 1st. Dr. Green said the administrative, executive and clerical force employed by that company would be reduced, but that the Western Union would find work for nearly all the operators. The latter do not accept this statement on its face. They know they will receive their wages for the present month, but beyond that they fear to calculate upon anything more cheerful than dismissal.

The entire plant of the Belvidere Electric Lighting company has been sold to George F. Wiley, of Philadelphia, by John Simmerson, auditor. The sale was made by order of the court under an attachment suit. The plant consists of a complete outfit, the property being seized by the sheriff about six months ago, on the night the first trial for lighting the town was to be made. A number of bills owing to the workmen and tradespeople are still unpaid, and will prove a total loss.

The board of electrical control had its regular weekly meeting on Thursday, in which the usual squabbles occurred. The mayor for some time has been complaining about the condition of our streets, and evidently thinks the board is responsible for a good share of their bad condition. So he opposes every measure made in the board to grant permits for opening more subways. At the meeting on Thursday, Mr. Gibbens offered a resolution to grant permits for opening about twenty-three miles of street. The mayor made a vigorous protest, and hinted that somebody might be indicted before night for this business. He understood, he said, that the grand jury now had the subject under consideration. The resolution was lost, and the mayor then moved that the board grant permits to erect poles to carry out contracts already made for lighting the city. This motion was also lost. As the matter stands now no provision has been made for the wires of the electric light companies that were recently awarded contracts for public lighting. Messrs. Gibbens and Moss wish to provide temporary subways for all these companies, while the mayor and Mr. Hess oppose opening the streets, and think that permits for poles should be given. Meanwhile these companies can take no steps toward equipping their lines for lighting the city.

Mr. Edison's new laboratory at Llewellyn Park, New Jersey, is nearly completed, and he expects to begin work in it some time next month. Special importance has been given to the selection of material for the storeroom, and money has been freely spent to provide all kinds of material for any possible use. It is said he has a supply of every kind of iron and steel, every kind of known wood, every kind of glass, every metal in all their different shapes, every stone, every variety of clay, chalk, every vegetable substance that may be of use, from the firs

of the Arctic regions to the giant grasses of the Amazon. Mr. Edison just now is very much interested in the practical development of his phonograph, and is enthusiastic over its possible uses. He is also at work on a cotton picker and a new device for propelling street cars by electricity. S.

Cincinnati Chat.

CINCINNATI, Oct. 22.—The Hauss Electric Light & Power company are pleasantly located at the corner of Canal and Walnut streets, and are very busy. They have in place and running to their full capacity three of the Hauss automatic dynamos and are preparing to put in seven more that will be completed by the first of the month. The inventions of Mr. Hauss have been the cause of quite a boom for Cincinnati, as there are now three distinct companies working under his patents. In addition to that named above there are: The Hauss Construction company and The Hauss Electric Manufacturing company. All of the companies are doing well.

The John Van Range company of this city have contracted with the Queen City Electric company for a 150-light plant, to be put in at once.

Doctor Potter, of Paducah, Ky., was in the city last week in consultation with H. B. Cox, of Fernbank, in regard to some of his electrical inventions. The fact that the doctor has been at this work for some thirty years back, and is well up in years, speaks very highly for the ability of Mr. Cox as a young man of extraordinary talent in this line.

Granville T. Woods, patentee of a telephone system and apparatus, is forming a company for the manufacture of his inventions.

The Geo. F. Card Manf'g. company are just moving into their new quarters at the corner of Second and Plum streets. They will devote themselves exclusively to the manufacture of electric motors, the invention of Mr. Card. Their orders now are being very much delayed on account of moving. The members of the company are John A. Gano, president; Henry K. Lindsey, vice-president; Geo. McLaughlin, secretary and treasurer; and Geo. F. Card, manager. They start out on a good financial footing, with prospects of immense business. M.

Kansas Towns.

STERLING, KAN. Oct. 19.—After considerable delay and disappointment the Wichita motor line at last began to "mote." At one time things looked pretty blue, so much so that the stockholders began to look around for a cable line. All difficulties, their electician, Mr. Sedden, states, have now been overcome, and the motor car and one passenger coach are running up and down on about three quarters of a mile of track. As soon as three more motors can be placed on the cars, the line will be opened for regular traffic. The line itself is some two miles long. This is a series—constant current—system, similar to the Short-Nesmith arrangement, with the difference, however, that here the circuit is overhead. The conductor consists of a copper tube ⅝ of an inch diameter, suspended over the center of the track. The conductor is divided into blocks or sections of 30 feet each, insulated from each other but mechanically connected by switches, which open and close the circuit alternately. Two contact carriages are used, one at the front end of the motor car, the other at the rear of coach; connected by flexible conductors with the motor. The first contact carriage as it is pulled along, opens the circuit on striking the switch, while the second carriage closes it after the coach has passed each section. So that the motor is always in circuit between two sections. A 40 horse power Brush dynamo at the station furnishes current for four motors of 10 horse-power each. A number 2 copper wire carried on poles from the extreme end of the line to the station completes the circuit. On a trial trip the coach and motor car were loaded with passengers so that the springs were down flat on the frame, but the train went up a grade of one foot in 100 feet without any apparent trouble.

The Archer Electric Mfg. Co. have closed a contract with the Anthony, Kan., Opera House Co. for lighting their new Opera house with incandescent lights throughout. Some 180 sixteen candle power lamps will be used. There will not be a gas or oil lamp in the building, and the good people of Anthony are very anxious to see a practical demonstration of the reliability of the electric light. Temporary arrangements for power will be made until the Anthony Electric Light and Power Co. have their station in operation, when the Opera House circuit will be transferred to that building.

From the Pacific Slope.

SAN FRANCISCO, Oct. 10.—The news of the absorption of the B. & O. lines by the Western Union, and the probable unloading upon a full market of a large number of the B. & O. rank and file, accounts for the long drawn visages that may be seen about the main office of the Western Union and Postal companies in San Francisco. All hopes are now centered in the Mackay lines as the operator's only haven. The Western Union company is evidently looking forward to a considerable increase in business in California; a new seven-wire cable has been ordered for service between San Francisco and Oakland, and new wires are projected in several directions.

John McRobie, late of Chicago, has been appointed manager of the Western Union office here, and improved facilities seem to be the order of the day.

D. S. Robeson, of Chicago, who came here in April to temporarily take charge of the Postal lines, has returned east, leaving behind him the reputation of having given the best telegraphic service that the Pacific coast has known, and bearing with him the good wishes of every employe. He was entertained at a banquet prior to his departure and presented an elegant watch.

The experimental electric street railway in Oakland, about half a mile in length, is in daily operation by Messrs Speed and Keith, and is pronounced a decided success. It is on the Speed-Jenkins series system. F.

Personal Paragraphs.

George Westinghouse, jr. and his brother Herman Westinghouse, of Pittsburgh, were in Chicago last week accompanied by other members of the company. They demonstrated the workings of the Westinghouse air brake to a large number of the engineers and other railroad men in attendance at the convention of the Brotherhood of Locomotive Engineers. The tests took place at Park Ridge and a special train of fourteen cars was provided on the Chicago and Northwestern railway to take the guests from Chicago to that place.

C. W. McDaniel, of the Missouri and Kansas Bell Telephone company, of Kansas City was in the city last week.

On the 17th inst., Clayton B. Clark, superintendent of the electric light company at Mobile, Ala., and Miss Mary B. Gunnison, daughter of Captain and Mrs. A. Gunnison, were united in marriage by Rev. J. S. Johnston.

Robert Garrett, ex-president of the B. & O. lines has leased a residence in the city of Mexico for the winter.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	390
Central Union	44	45
Michigan	73	74
Great Southern	28	30
Colorado	18	20
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	155	157
Iowa Union	25	27
Missouri and Kansas	69	70

THE ELECTRIC LIGHT.

It is hoped to have the river lighting plant, now being put in for the city of Chicago, in operation about December 1st.

Edgewater, a suburb of Chicago, the only town in the United States lighted solely by electricity, is having its Edison plant doubled in size.

Sixteen electric arc lights were placed in the Carbon hill coal mines, southeast of Tacoma, W. T. on the 13th. These mines belong to the California Improvement company of the Central Pacific system.

An ordinance granting Frank Wood, of Boston, Mass., and T. H. Stevens, of Anthony, Kansas, the right to erect and operate a system of electric lighting and electric motive power in the city of El Dorado, Butler county, Kansas, has been passed and approved by Mayor McGinnis.

October 11th two electric light wires in New Orleans crossed, and the result was a call for the fire department to turn out. The damage was insignificant.

Orators County-attorney Cory, A. A. Osgood, W. L. Simons, Angell Matthewson, J. J. Everingham and Rev. H. A. Tucker, whose efforts were ably supplemented by four bands, gave a royal welcome to the electric light in Parsons, Kan., a short time ago. The Thomson-Houston system is used. The dynamo used has a capacity for lighting thirty-five street or arc lights of two thousand candle power each, but the engine and boiler are of sufficient size to run two additional dynamos should the necessity for doing so arise. The company begins operation with thirty-three arc and a number of incandescent lights almost equal to the present capacity of the works.

The People's Electric company of Streeter, Ill., are making preparations to start their electric light plant again. This plant consists of 75 lights of the Van Depoele system. Last spring the merchants agreed to close at six o'clock each evening, and this action reduced the plant to comparative idleness during the summer season.

The Dennison Electric Light & Power comwany of Dennison, Tex., have ordered another 60-light machine and as many lamps from the Van Depoele Electric Manfg. Co., of Chicago. This order just doubles their capacity, and contracts have been taken for the 120 lights. For some time the company had been burning 68 lights from a 60-light machine, but wisely concluded to put in another dynamo.

The Edison Electric Illuminating company of Rochester, N. Y., during the summer has erected 1,200 poles and strung 180 miles of wire.

It costs the town of Paris, Ill., nearly $4,000 a year to operate its electric-light plant.

In the *English Post-office Circular* of recent date appear the following: "A vacancy for an electrician has occurred in the colony of British Guiana. Salary £350, by £10 per annum to £400. Deduction of 4 per cent. from salary towards widows' and orphans' fund. Pension of one-fiftieth of salary for each year of service after ten years' service and fifty-five years of age. When traveling on duty in the colony the electrician is paid actual traveling expenses, and a personal allowance of 16 shillings 8 pence a day when absent from fixed residence. At the request of the secretary of state for the colonies applications for this situation are invited. The officer selected will be required to take technical charge of the government land lines and cables, under the superintendence of the postmaster-general of the colony." There is nothing extraordinary in the inducements offered but there is a large difference between the salary named and $60 a month for which some companies think they ought to get the best of expert electricians

THE ELECTRIC MOTOR.

At Woonsocket, R. I., on the 19th a successful exhibition was made of a street car run by a Thomson-Houston motor.

It is announced that Rochester, N. Y., is to have its electric railway from the city line to Charlotte, along the bridle path of the boulevard. The three companies in interest, the street car company, the boulevard company and the electrical company, have formed a union company. The system to be used has not yet been made public.

A recently incorporated company is the Illinois Wooley Electric Motor company of Chicago; capital stock, $100,000. The company will deal

in and operate electric engines and motors; incorporators, Clair D. Vallette, Albert N. Eastman, and Edward E. Gray.

In Topeka, Kan., between twenty-five and thirty electric motors are in daily use.

The Abilene *Gazette*, published at Abilene, Kan., has an electric motor to run its press, and thus commends it: "We can therefore speak from experience when we say that it is a perfect power. There is nothing can equal it, and it is much cheaper than power. On the one hand it is a small compact motor, needing no care, taking up no room, making no dust nor dirt, always in order. On the other hand there is an engine and boiler to be bought, fuel, an engineer to employ, increased space taken up, dust and dirt on all sides, something always out of gear, and what is more to the point, a much larger running expense than the electric motor. Which is preferable? It is not a very hard problem to solve. This electric motor power is just the thing for light manufacturing purposes. Motors are now in use which furnish as high as thirty-five horse power. The *Gazette* press is run by a three horse power, and has not caused a bit of trouble at any time, except to turn the power on and off, since the day it was put in. That it is the best power known, is conceded by all who have ever used it, or know anything about it. That it is not more in use in Abilene is a surprise to us, when the saving it makes and the convenience it is, is taken into account."

The Wichita, Kan., *Daily Eagle* of the 20th says in regard to a trial of the Riverside electric motor line: The engine which drives the dynamo was in motion and a splendid new car was standing on the track in front of the engine house. Quite a number of persons were collected to witness the experiment when the manager gave notice that if any one present wanted to take a ride they were at liberty to get aboard. The car was soon filled when the electric power was applied and the car moved off. There was no noise or jar. Noiselessly and swiftly like a sail boat over the waters of a placid lake, the splendid car shot through the park and across Elm street bridge to Waco avenue. It was run back and forth slowly and then the speed increased to ten miles an hour until the spectators were all satisfied that the electric motor line is a success. One man said he expected to see passenger cars run on the railroads all over the country by electric power in a short time. Several persons who claimed to know all about cable lines said "the electric motor is bound to supersede the cable." Major Powel was an interested spectator, said that he believed the time would soon come when all street cars will be propelled by the electric motor.

THE TELEGRAPH.

October 15th all the telegraph wires leading into Charleston, S. C., were suddenly interrupted and it was impossible to get communication with that city for several hours. Naturally enough there were rumors of seismic disturbances and there was considerable speculation. Finally it was ascertained that a grocery at Magnolia crossing just outside the city limits had been destroyed by fire and that all the telegraph wires leading from the city, which centered near the building, had been burned, thus cutting off communication entirely.

A prominent cotton-buyer of Athens, Ga., has filed suit against the Western Union Telegraph company for damages owing to the mis-sending of a word in a telegram. It seems that two words were used—"sniffle," and "snifle," but with entire different meaning. The buyer received the word "sniffle." He thought there was a mistake, and wired back to know if "snifle" was not meant. The answer stated that the proper word was "sniffle." The merchant shaped his transactions accordingly, and experienced a loss of $1,800. He has employed counsel, and filed suit against the Western Union for a recovery of this amount.

The gross earnings of the Western Union Telegraph company for the year ending June 30th, were $17,191,909; operating expenses, $13,154,628; net earnings, $4,037,281; interest and sinking fund, $533,065; balance, $3,504,216; dividends, $811,864; surplus from the year's business, $2,692,352. The last feature is the vital one, as it compares with a deficit in meeting charges last year of $14,169. The number of messages handled reached the enormous total of 47,394,530. The average receipts per message was reduced to 30¼ cents against 30 9-10 cents the previous year, with a reduction in the cost of handling to 23¼ cents, against 24 cents the previous year. The report concludes by saying that the facilities and advantages afforded by the addition of the Baltimore & Ohio system, it is confidently believed, will largely increase the revenues. This acquisition and others made since the close of the fiscal year and not included in the report will swell the company's plant to about 162,000 miles of line and over 580,000 miles of wires.

It is reported that the North American Winnipeg extension will be pushed to completion before next spring.

The United States Coöperative Capital and Labor Traffic filed articles of association with the secretary of state of Wisconsin on the 14th; capital stock, $20,000,000. The object is to operate telegraph lines, deal in stocks, mines, manufacturing, etc. The incorporators are generally Milwaukee men, and the seat of operations will be in that city.

A New York press dispatch of the 21st. credits Dr. Norvin Green, president of the Western Union Telegraph company with the statement that it is intended to make a uniform rate of 25 cents for ten-word messages from any point to any other point in the same state in all of the territory east of the Mississippi river

The Western Union Telegraph company began suit the 21st in the United States court in New York against the French Cable company, to enjoin it from interfering with the former's wires which run from New York to Cape Cod. The French company had leased these wires from the Western Union company, but was forced to give them up on account of a law in France which forbids any French company entering into a contract with an alien unless it is sanctioned by that government. The French people want to put up their own wires, and had threatened to tear down the Western Union's wires unless they were removed at once.

THE TELEPHONE.

The Iowa Union Telephone company has decided upon an extension of its lines in southwestern Iowa, with Creston as the objective point for all new lines. Contracts have been let for a line from Cromwell to Corning, and from Corning to Villisca.

Another batch of telephone suits have been precipitated by the American Bell and Central Union Telephone companies, the same being a counterpart of those previously filed in the federal court against patrons of the Wallace system of telephoning. The defendants in the present suit number fifty-one, all of them residents of Elkhart, and there are the same allegations as to infringement of patent that were embraced in those previously filed.

The German government has refused to fulfill its promise to establish telephone connection between Verviers and Aix-la-Chapelle. The reason for its refusal is probably the same as that which caused it to close the telephone communication between Mülhausen and Basle recently. Public opinion strongly condemns the government's action.

Business Mention.

The ease with which temporary installations of the electric light can be made is more noticeable the more frequently they are made. If available power can be obtained the whole matter is practically settled. The temporary installation put in the Palmer house for the Geneva Non-Magnetic Watch company and the lighting of the presidential arch, both done by C. C. Warren, the western manager of the United States Electric Lighting company, are cases in point.

The Western Electric company, of Chicago, have recently received an order for a 60 arc light outfit for the Scranton Illuminating company, of Scranton, Pa. They also have orders for a 40 light dynamo for Kankakee and one for East Liverpool, Ohio, increasing the plants already running in those cities.

Leonard & Izard, constructing engineers, 185 Dearborn street have secured contracts for Edison plants as follows: Jamestown, D. T., central station, 600 lights; Decatur, Ill., central station, 600 lights; Pullman Palace Car works at Pullman, Ill., a plant of 750 lights; an additional plant of 300 lights for the Edgewater, Ill. central station, making the capacity 600 lights; a plant of 150 lights for Crane Bros., making the fourth order from that company; Desplaines Valley company, Lockport, Ill., 40 lights; Chicago & Northwestern Ry. Co. shops at Clinton, Ia., 350 lights; Peru, Ill., central station, 450 lights.

The Harford Electrica Company has been organized, with headquarters at East Saginaw, Mich., with a capital stock of $50,000. The officers are: J. P. Langley, president; H. A. Forrest, secretary and treasurer; A. B. Harford, electrician. They are prepared to place their combined system of clock, automatic guest call and fire alarm in any hotel or private house and guarantee satisfaction.

Electrical Patents.

Issued, October 18, 1887.

371,536. Brush Shifter for Dynamo-Electric Machines. Edward H. Amet, Chicago, Ill.

The brushes are automatically shifted to prevent sparking during the variations of the load or resistance of the external circuit.

371,555. Anti-Induction Device. James Curren, Portland, Oreg.

For use in connection with telephone circuits. A loop, with one side near the disturbing electric light circuit or other disturbing influence, is connected into the talking circuit. The direction or polarity of the loop near the disturbing circuit is opposite to that of the portion of the telephone line which is near the disturbing influence.

371,557. Means for Preventing Induction on Electrical Conductors. Stephen C. Drew, Boston, Mass.

The primary coil is in circuit with the main line, the current from the sending station passing through this primary to ground. The receiving telephone is in the secondary coil. The induced currents from other wires being less than the current on the main line will be suppressed, that is, will not be strong enough to excite tertiary currents in the secondary coil which includes the telephone.

371,559. Electric Motor. Richard N. Dyer, East Orange, N. J.

By means of demagnetzing coils in the main line, the force of the magnet of the motor which controls the register, is varied to increase or decrease the speed of the register according to the strength of the current.

371,570. Socket and Key for Incandescent Lamps. John J. Fisher, Allegheny.

371,583. Electrical Registering Device. Arthur S. Hobby, Cincinnati, Ohio.

371,626. Device for Indicating Life in Buried Persons Carl Redl, Vienna, Austria, Hungary.

371,640 Electrical Alarm and Recorder for Oil Presses. Erwin W. Thompson, Charlotte, N. C.

371,655. Electro-Magnetic Brake Apparatus. Granville T. Woods, Cincinnati, Ohio.

371,664. Electric Forceps. John Brannan and William E, Stone, Denver, Col.

The jaws of the dental forceps are provided with electric conductors. The circuit is completed as the points of the jaws touch the tooth

371,670. Railway Signal. Edward M. Chase, Boston, Mass.

A gong at a railroad crossing is sounded previous to and continued until the arrival of the train. The gong is operated by clock work, which is released by mechanism operated electrically by the passing of the train.

371,681. Conductor for Electric Wires. John Grant, Omaha, Neb.

371,696, Electric Alarm Clock. Simeon P. Meads, Oakland, Cal.

371,720. Electrical Indicator. Montgomery Waddell, New York, N. Y.

371,752. Electric Call or Signal Apparatus. George W. Foster, Galveston, Texas.

The invention consists in means whereby a polarized electric bell may be operated, not only by alternating currents, but also by constant currents of the proper polarity. The invention applied to telephone subscribers' bells, permits tests to be made of the lines from the central office; straight current being sent to line actuates the armature of the bell slightly without causing the bell to ring, and the operator listening at a telephone and hearing the sound caused by the vibration of the bell armature, knows that the line is complete.

371,755. Vibrating Rheotome. John R. Hard, New York, N. Y.

371,757. Telephone Holder. Augustus L. Hott, Cincinnati, Ohio.

371,808. Joint for Lead-covered Cables. Richard S. Waring, Pittsburgh, Pa.

371,840. Electric Circuit Connection. Samuel Heffner and John H. Phillips, Pottsville, Pa.

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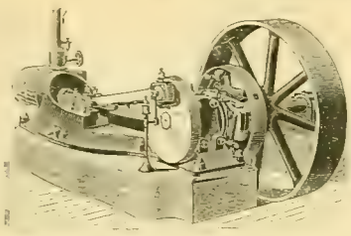

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Electric Light, Telephone and Telegraph **WIRES AND CABLES** for Aerial, Submarine and Underground uses.

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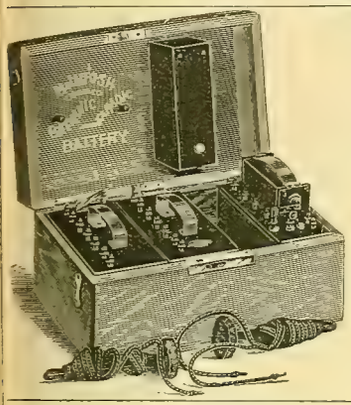

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COMBINED GALVANIC AND FARADIC BATTERIES,
STATIC MACHINES, ELECTRIC MOTOR for Static Machines,
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and EVERY VARIETY OF ELECTRICAL INSTRUMENT employed in treating disease.

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The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

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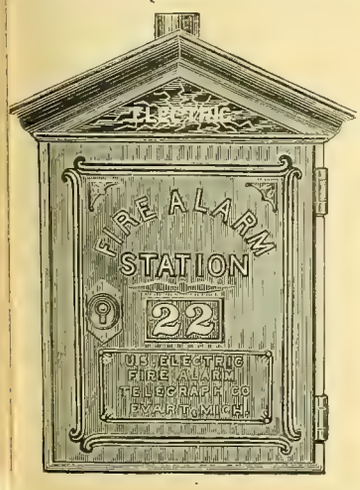

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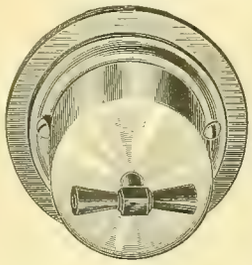

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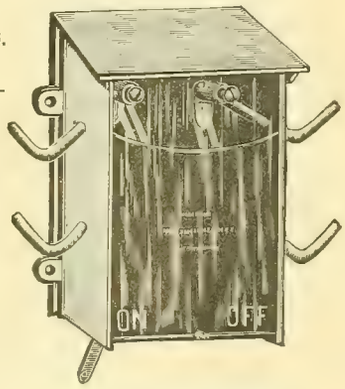

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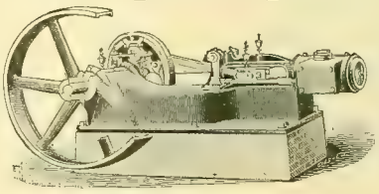

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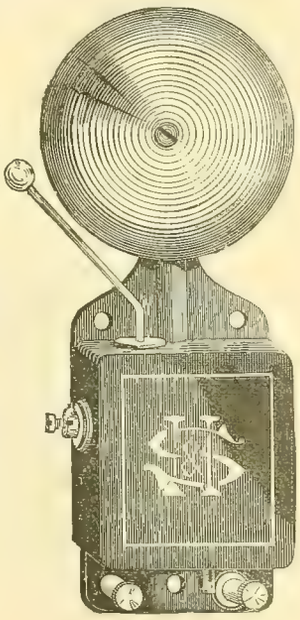

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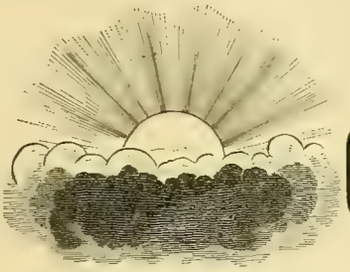

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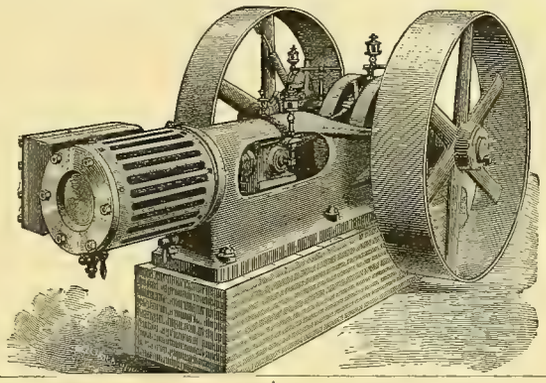

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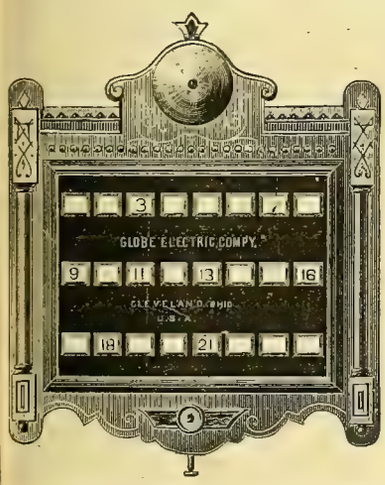

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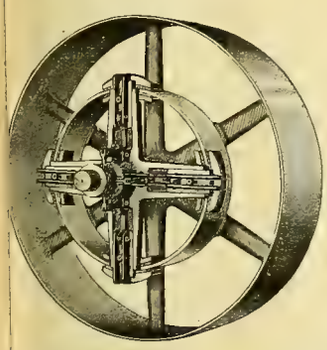

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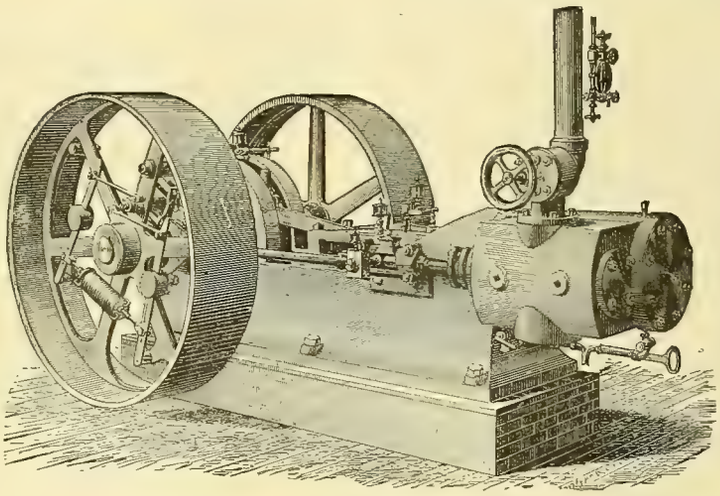

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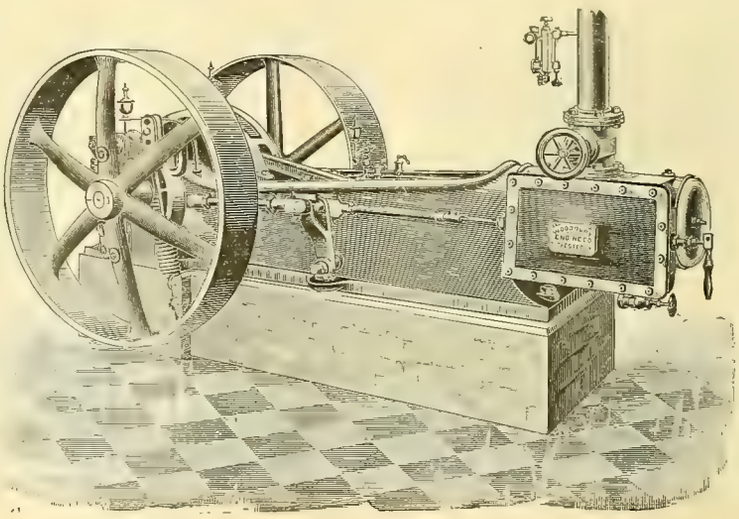

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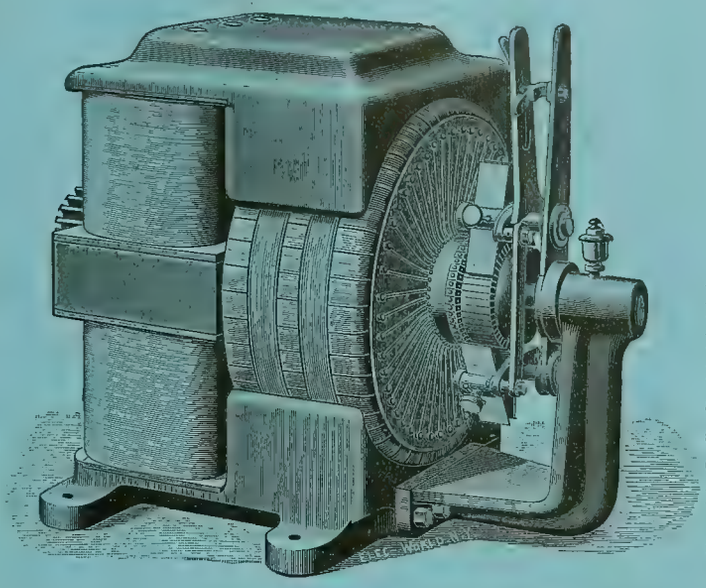

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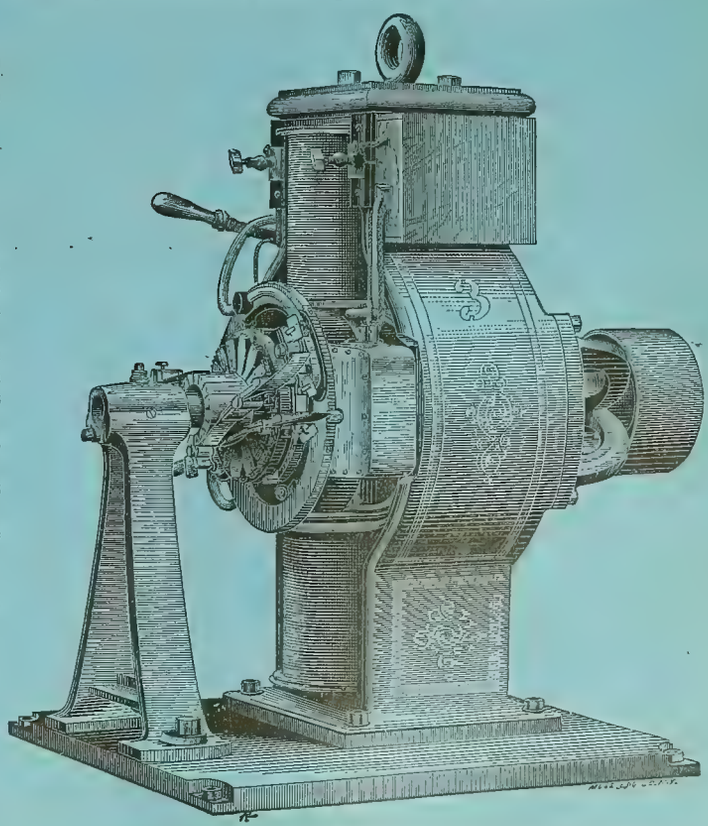

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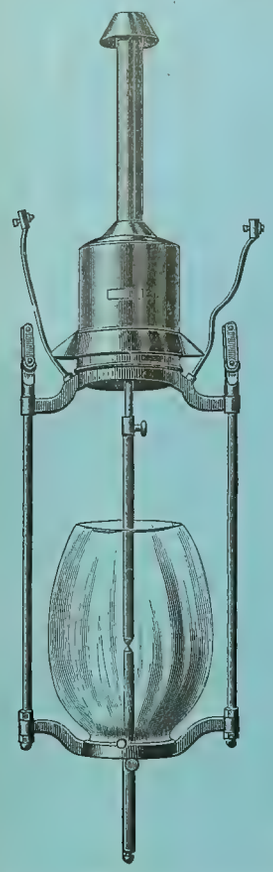

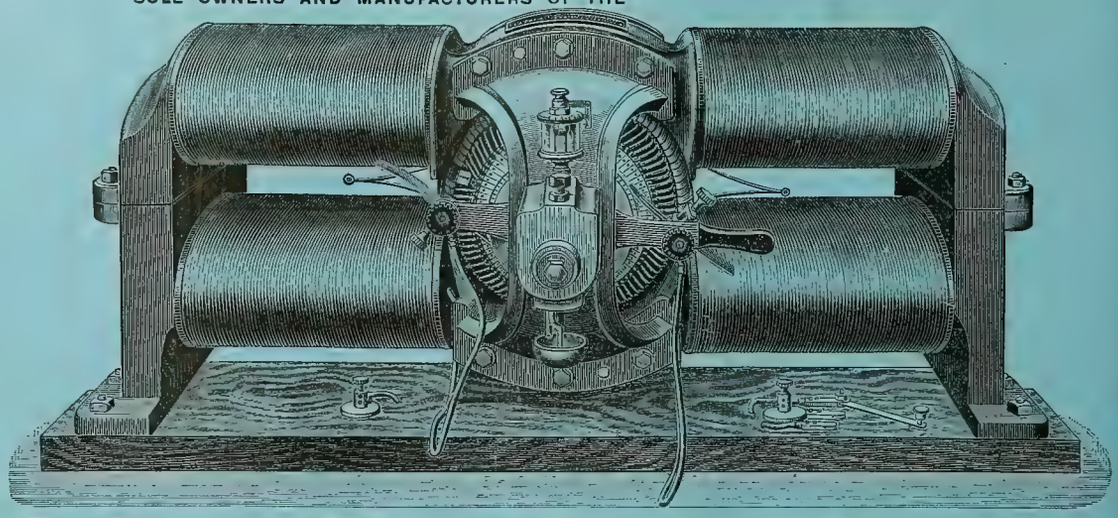

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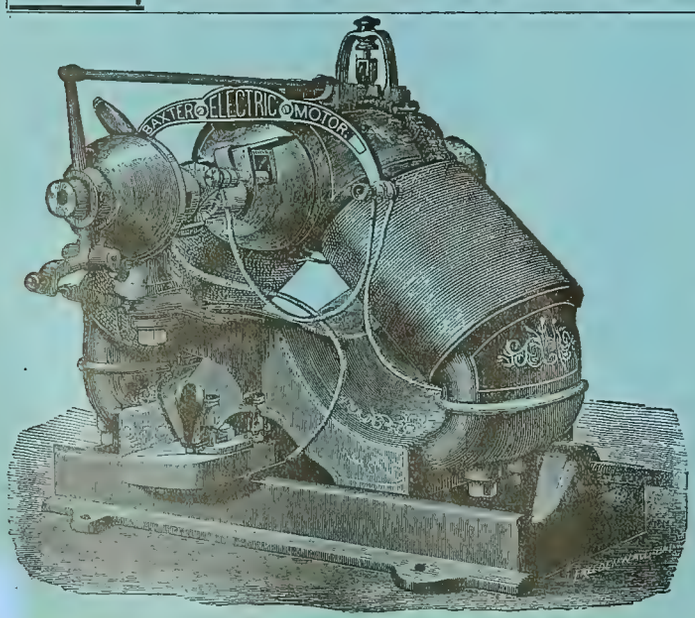

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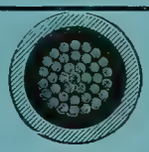

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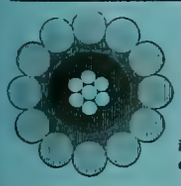

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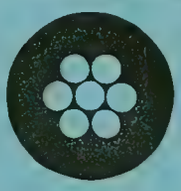

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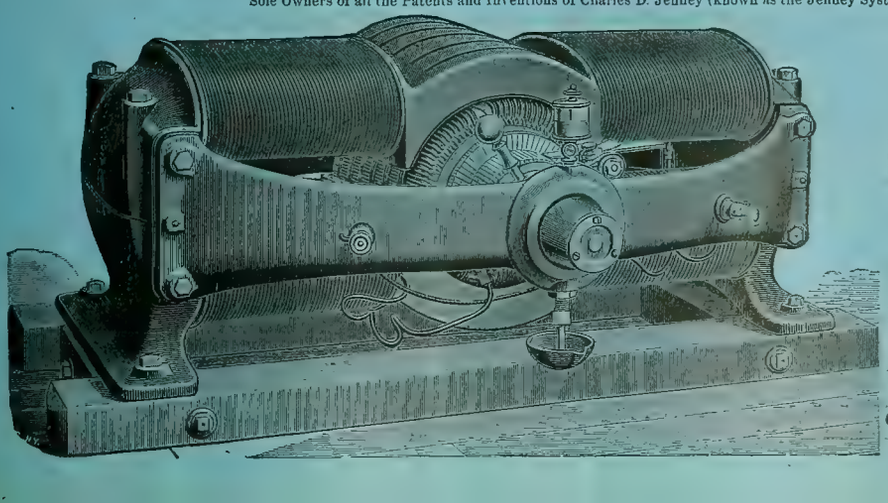

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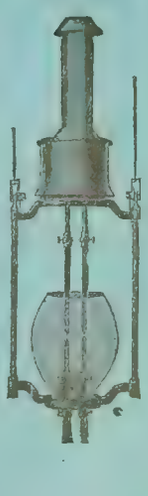

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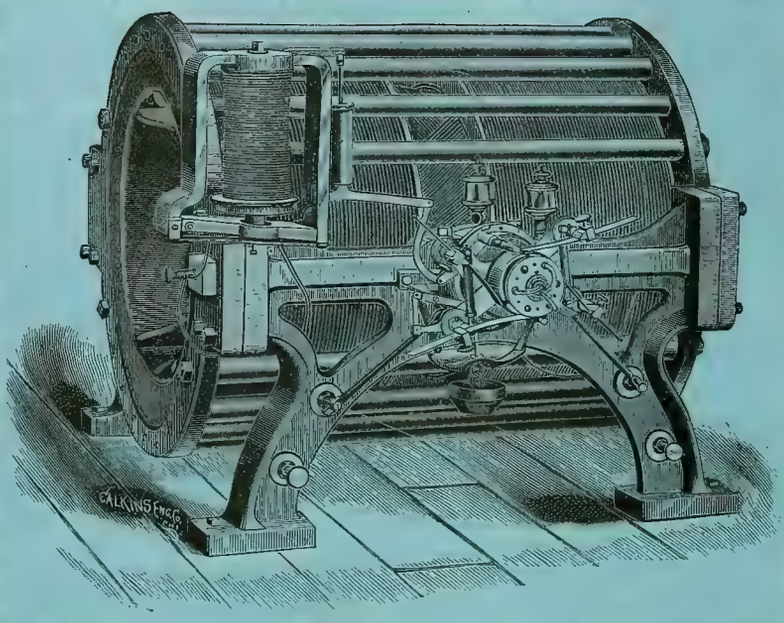
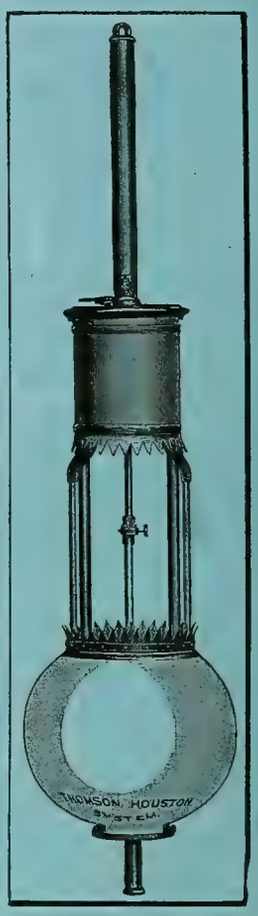
The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

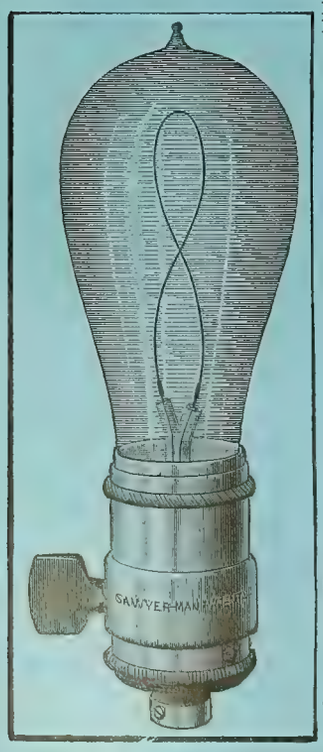


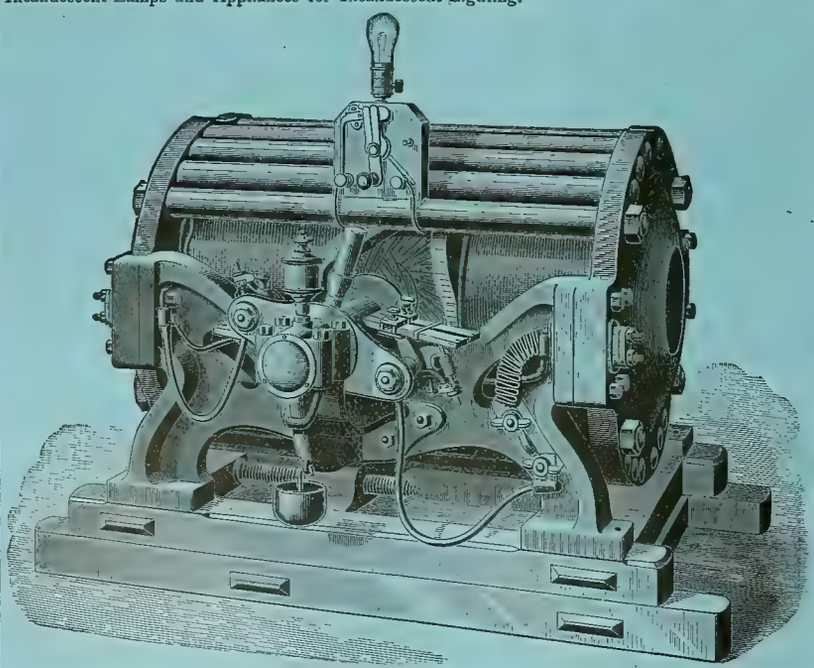
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

THE MATHER ELECTRIC COMPANY

MANCHESTER, CONN.

H. G. CHENEY, Pres. ROBERT CHENEY, Vice-Pres. P. H. WOODWARD, Sec. and Treas. N. T. PULSIFER, Gen'l Mang'r.

R. H. MATHER, WM. A. ANTHONY, Consulting Electricians.

New York Office, 35 Broadway. Chicago Office, 38 LaSalle St. Boston Office, 143 Federal St. Cincinnati Office, Carlisle Building.

INSTRUMENTS OF PRECISION.

We make Instruments for Electrical Measurements, adjusted to any degree of precision required for any purpose. Resistance Boxes are made with any required series of resistances, with and without proportional coils for bridge.

All resistances are adjusted to legal ohms by standards tested at the Cavendish laboratory and certified by the British Association Committee.

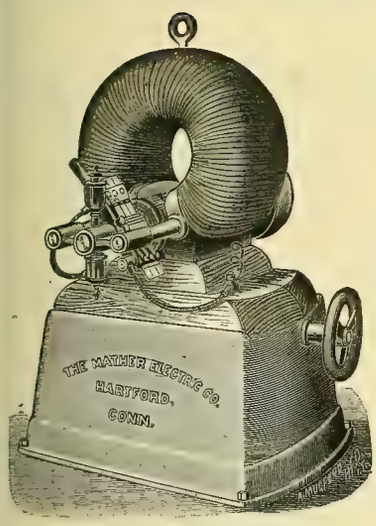
IN RESISTANCE BOXES

required for physical research, all the coils will be made from one piece of wire to insure a uniform temperature coefficient.

Galvanometers are made of high and low resistance, aperiodic and astatic, or not, as required. Tangent Galvanometers of any capacity will be made to order.

Ammeters, Voltmeters and resistance coils will be calibrated and constants furnished.

The Mather System for Incandescent Lighting.



The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and

DO NOT BLACKEN IN USE.

Our Dynamo is very simple in construction, runs without spark at the commutators and can be operated by any one accustomed to the care of engines or machinery. The system has no equal for mills, machine shops, or other places requiring isolated plants, We shall be pleased to furnish estimates for complete installations, with or without motive power, and will send one of our experts to examine the premises, if necessary.

MOTORS.

We furnish motors from one-half horse power upwards, for constant potential circuits, perfectly self-regulating without special regulating mechanism. Motors are also furnished for constant current circuits.

Incandescent Lamps and Sockets for Private Users.

We Furnish Lamps of 16 Candle Power each, for Potentials from 50 to 110 Volts, for use with any Machine.

Chicago Office, 38 LaSalle Street.

THE TUCKER ELECTRICAL MANUFACTURING COMPANY,

35 BROADWAY, NEW YORK CITY.

Sole Agents of the MATHER ELECTIC COMPANY for the States of New York, New Jersey, Missouri and Iowa.

ST. LOUIS OFFICE, 308 N. EIGHTH ST., TURNER BUILDING.

THE NATIONAL CARBON CO.

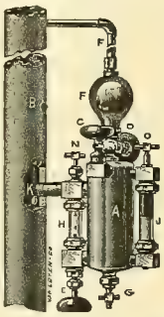
CLEVELAND, O.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

Chicago Electric Club.

There will be a meeting of the CHICAGO ELECTRIC CLUB, Monday evening, November 7, at 8 o'clock, at the rooms of the Club, 122-124 Clark Street.



The Detroit Sight Feed Lubricators

Are pronounced the best by more than 20,000 users. They are especially adapted to

HIGH SPEED ENGINES FOR ELECTRIC LIGHTING

Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

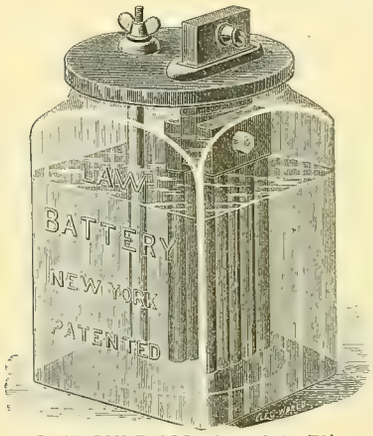
"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

Liberal discount to the trade. Send for Circular and Price List.

DETROIT LUBRICATOR CO.

Office, 11 Rowland Street, - DETROIT, MICH.

THE IMPROVED "LAW PRISM" BATTERY



SIZE OVER ALL, 4¼ x 4¼ x 7½.

THE NEATEST OF ALL BATTERIES. THE BEST AND CHEAPEST.

With the exception of glass broken by carelessness, and the zinc and sal-ammoniac consumed in the production of current, **all parts of this Battery are Guaranteed** to be **Everlasting.** Perfectly **uniform** and **reliable** in action, of **faultless construction** and **beautiful appearance.**

PERPETUAL NEGATIVE ELEMENTS!!!

These consisting of specially prepared prisms of Carbon are fine depolarizers, performing this function indefinitely, **do not require renewal**, as is the case where chemical depolarizers are employed, thus a **great economy** is effected. These cells are so constructed as to prevent evaporation of the solution, and crawling out of the salts. Thousands of these cells now employed for **Telephone Transmitters, Gas Lighting, Annunciators, Burglar Alarms** and other **Automatic Devices** are giving **Perfect Satisfaction.**

The many Physicians now using the "**Improved Law**" as an office battery, are unanimous in their expressions as to its perfection and adaptability for electrolysis and general galvanization, requiring no renewal nor attention in from two to five years, the latter depending only on the amount of use.

Note:—This battery is not suitable for Galvano Cautery nor Incandescent Light purposes.

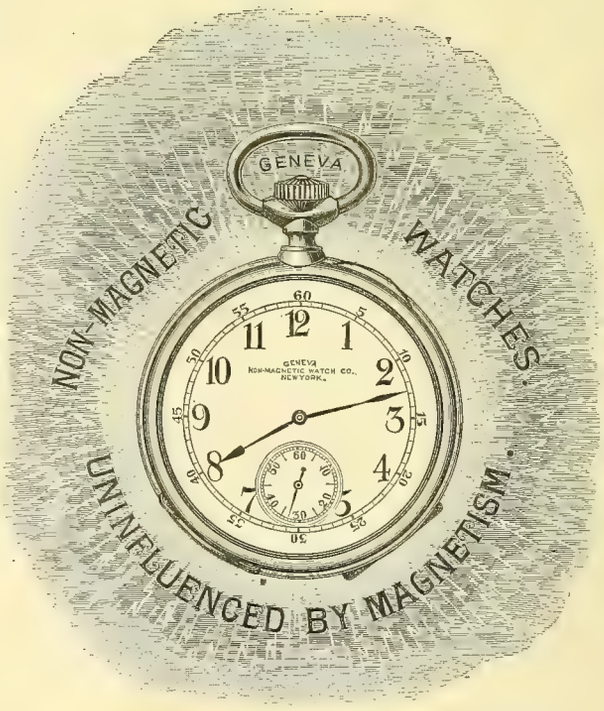
LAW TELEPHONE CO., Sole Manufacturers, 112 LIBERTY ST., NEW YORK.

Geneva Non-Magnetic Watch Co.

(LIMITED.)

Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode.

Ask your Jeweler for them.



Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the WORKS, they require no shield or other protection.

Send for Catalogue.

177 & 179 Broadway, New York.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS OF

Steam and Hydraulic Machinery.

Complete Steam Plants for Electric Light and Power.

Western Agents for Armington & Sims' Engines, Steel Tubular Boilers, Jarvis' Patent Furnace, National Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Jenkins' Bros. Valves, Etc. Also, Brick and Pipe Work, and Belting.

SEND FOR LATEST CATALOGUE.

707 and 709 MARKET STREET, - ST. LOUIS.

BRANCH, 521 DELAWARE ST., KANSAS CITY.

Holmes, Booth & Haydens,

25 PARK PLACE, NEW YORK.

MANUFACTURERS OF

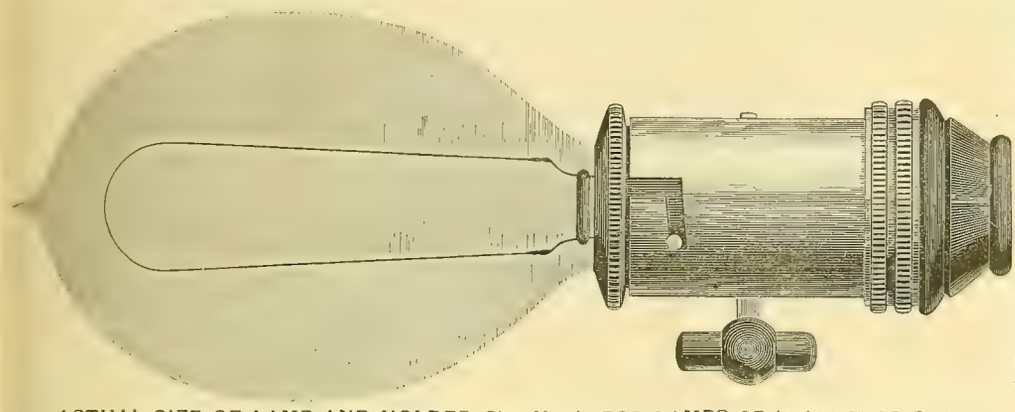
Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

Western Agency, 185 & 187 Dearborn St., Chicago.



ACTUAL SIZE OF LAMP AND HOLDER (Size No. 1,) FOR LAMPS 65 to 100 V. 16 C. P.

Aluminous Incandescent.

We do not manufacture Dynamos or deal in them, nor do we erect or maintain any electric plants whatever. Our business is solely the manufacture of LAMPS (or Luminoids) with our own Fittings, under our own patents and devices for any system or purpose of any voltage, size or candle power (on hand or made to order). We solicit the patronage of Electric Light Co.'s and large users.

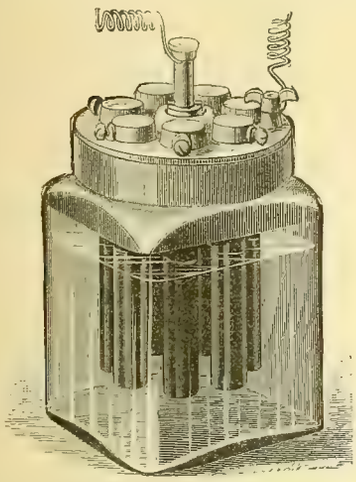
CORRESPONDENCE REQUESTED.
CATALOGUES ON APPLICATION.

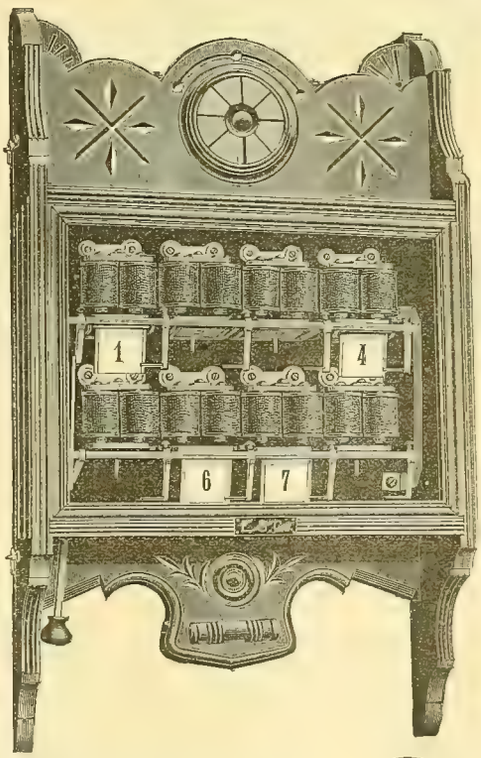
VITRITE & LUMINOID CO., 182 FULTON ST., NEW YORK.

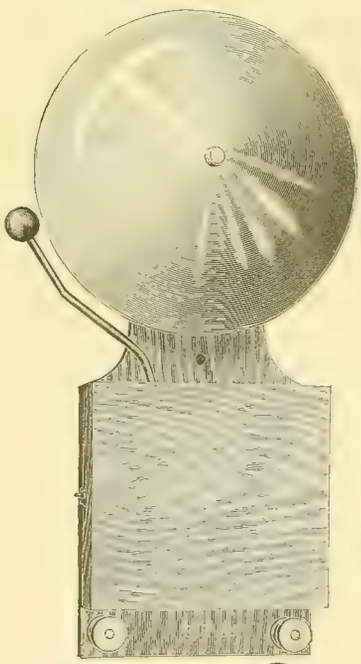
ELECTRIC HOUSE GOODS.

Annunciators, Bells, Batteries, Push Buttons.

A Large Assortment, Thoroughly Well Made.







THE ELECTRICAL SUPPLY CO.,

FACTORIES:
ANSONIA, CONN.

171 Randolph Street, CHICAGO.
17 Dey Street, NEW YORK.

DISQUE LeCLANCHE BATTERY.

We make the best Disque LeClanche Battery in the market, and guarantee it.

We will replace, without charge, any porous cup which fails to give satisfactory service within nine months from the date of its manufacture, if the cup be returned to us sound and whole.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

THE EDDY ELECTRIC MANUFACTURING CO.

MANUFACTURERS OF **Automatic Electric Motors** (MATHER PATENTS.)

In all sizes from ½ H. P. upwards. The efficiency of these Motors is over 92 per cent. They require no rheostat, are perfect in regulation, simple in construction, and thoroughly and substantially built. Also manufacturers of

THE MATHER DYNAMO ELECTRIC MACHINE,

FOR ELECTRO-PLATING, ELECTROTYPING, COPPER REFINING, ETC.

These Machines cannot reverse, use no water, do not spark, and are noiseless. Satisfaction Guaranteed.

THE EDDY ELECTRIC MANUFACTURING CO., HARTFORD, CONN.

READ THIS.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."

J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT,
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously installed by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 500 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C. C. Warren Esq.
Dear Sir. I have written the answers opposite your questions above as per your request, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.
Yours truly, J. F. Conklin

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, NOVEMBER 5, 1887. No. 19

The Card Electric Motor.

These motors have lately been placed upon the market by the Geo. F. Card Manufacturing company, of Cincinnati, Ohio. They are intended for arc and incandescent circuits, the motors of type B shown by Fig. 1, being for incandescent circuits, and the motor of type C shown by Fig. 2, on the succeeding page, for arc circuits. The armatures are of the Gramme type, with interchangeable parts fitted with the greatest mechanical accuracy. The shafts are of tool steel and run in bearings of phosphor bronze. All the construction has been made without the use of solder.

The ring armature invests the attraction of the field with great coercitive power, the effect being proportionate to the distance from the circumference of the ring to the axis of rotation. The ring armature has, as might be expected, the steady motion and driving force of a fly wheel. In the matter of ventilation, the advantages of the ring form must be apparent Any heat due to a temporary excess of current is dissipated, and the danger of injurious heating of the coils is greatly reduced. There is no dead center in these motors. Each armature is perfectly balanced before it is put into the machine, and can be run at the highest speed without noise or vibration.

The wiring is held in place by a strong band, which prevents its yielding to centrifugal force. All parts of the armature are accessible, and it can, by means of a screw driver, be taken apart, if necessity should require.

The commutator is of novel design, the sections being removable. By loosening the screws shown in the cut, Fig. 3, on the following page, the sections can be taken out without disturbing a wire and reversed in a few minutes, so as to get the greatest possible wear out of the metal. If worn out on both sides, so as no longer to be of service, new sections can, after the same fashion, be easily substituted.

The constant potential motor of type B is wound for a 2½ ampère current. It is the same size and construction as type A, with an added arm to increase the winding upon the field. The field and armature are in series. It measures 6x7½ inches by 5 inches in height, and weighs, without base, 9 pounds.

When placed on an incandescent light circuit a resistance has to be introduced. This is due to the impracticable conditions of winding upon a small motor the amount of wire that is required to sufficiently reduce the current. The resistance is made up of incandescent lamps of lower voltage than the dynamo from which the current is obtained. The lamps can be turned out singly, or the current thrown off from the motor without disturbing the lamps. A reflector enables one to utilize the light from the lamps, which run almost up to full candle power.

The lamps being in parallel to each other, the resistance is increased by turning them out of circuit, and the speed of the motor can thus be reduced at will. By using a larger number of lamps, of the same voltage as the dynamo, an increased number of variations in the speed can be effected.

The constant current motor of type C, is wound for a 5 ampère current. The field and armature are connected in series, and the motor will with that current attain a speed of 4,000 to 5,000 revolutions per minute. It measures 6 x 6 inches by 5 inches in height, and weighs, without base, 8½ pounds.

A shunt is used on the arc light circuits. This device made of carbons, avoids the incongruity of turning a current of 10 ampères, with enormous e. m. f. through the necessarily small brushes and commutator sections of a small motor. In the shunt the carbons are of a size sufficient for the current to pass through them without injury. The shunt also serves as a convenient means of regulating the speed, five variations being in this way provided for. A switch closes the circuit when the motor is not in use, no resistance being then interposed.

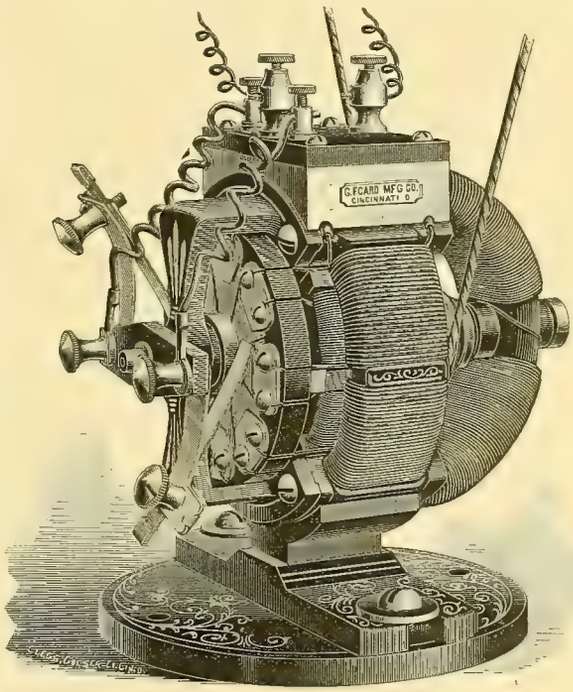


Fig 1.—Motor for Incandescent Circuits.

The Electric Light for a Fire Department.

Professor J. P. Barrett, city electrician of Chicago, has devised and has now under way what promises to be a very useful adjunct to the fire department. It is nothing more nor less than an electric light to be carried in a wagon and to be used for illuminating the fronts of huge buildings or dark alleys or streets. The apparatus consists of a number of cells of storage battery, which will furnish current for an arc light of about 1,200 candle power, or a large incandescent lamp. In either case the light will be placed in a focusing lamp like a locomotive head-light, which will be so arranged that it can be revolved to the right or left, so as to throw the light where desired. The cells will weigh, it is calculated, in the neighborhood of 300 pounds, and the whole apparatus will not be too heavy for a single horse to draw with ease. The wagon will be provided with light springs, so as to reduce the motion of the liquid in the cells, caused by the jolting, to a minimum, and the cells themselves will be made deeper than those ordinarily in use, to prevent the liquid from being splashed over the sides. If this portable electric light apparatus proves as useful as it promises, Professor Barrett, avers that every battallion in Chicago will be provided with one.

Magnetism in Watches.[1]

By C. C. Haskins.

The restless march of progress carries with it, either as a part of itself or as camp followers, the entire world of art, of science, of invention. Advancing civilization heralds a new born necessity—progress clamors for an invention to satisfy the hunger and clothe the form of the whimpering babe. Twenty-five years ago men would have thought it indicative of imbecility to have ridden in a street car. The lakes were good enough for any traveler, and in the days of those side-wheeled, floating, passenger palaces that transported, fed, and slept emigrants enough on a single trip to people a Dakota village, the world was satisfied to move at a much slower pace than now. Strap rails and longitudinal sleepers bore trains that could hardly keep ahead of the farmers' yelping dogs that followed them, and a single track was sufficient for all the needs of the traffic along roads where, to-day, there are double and quadruple tracks, and the vibrations arising from the passage of one train hardly subside before the echoes are again awakened and another monster engine hastens on in the wake of its predecessor.

In those old days there was not the necessity, as to-day, of an accurate time-piece in the pocket of the conductor or the man at the throttle. One passenger and one freight each way was, in many instances, all that was required of the road, and there was almost no end of roads where two engineers and two "strikers," as they were called, comprised the total entry on the pay sheet, under the heading of "engine service."

Along about the middle of the road somewhere there was a meeting point for the two trains; but there was no telegraph, and there was no necessity for a dispatcher. The trains met at that point, or they flagged, and that was all there was of it. The passengers all knew the train men, and seemed as a rule to enjoy any little delay there might be, especially if the side track was near a berry patch.

As a contrast to the present way of handling that sort of thing, let me give you the results of an invention by the chief engineer of a road which I think first came here from the east, and which is to-day one of the busiest of thoroughfares in the chain of roads from ocean to ocean. Business had so increased that it became necessary that some means of better accommodating the traffic should be invented. The invention came, and a copy of the time-card, which was the result of that invention, would be a curiosity to-day. The time of train number 1 was given as it now is. As long as that train kept on time it was run by that column; but when it fell a certain number of minutes behind it was run upon a second time-column called "first delayed" time, and a "second delayed" time filled the third column of the "table," as it was called. When this third right was lost, the balance of the trip was made in the wake of a brave boy, who carried the red flag of distress, and had no rights that even a ditching train was bound to respect.

I once heard a construction train conductor claim to the superintendent that his bull's-eye watch was correct because he set it by the minister's time. It was Monday morning, and having

[1] Prepared for the Brotherhood of Locomotive Engineers in twenty-fourth annual convention at Chicago, October 19-31, 1887.

tired of the long sermon, he had played with his watch in church the day before and corrected it by the clock over the pulpit.

Times, men, methods, all have changed. A minute to-day is worth in value what several were in the olden days. That kind of time, that sort of watch, that order of conductor will hardly fill

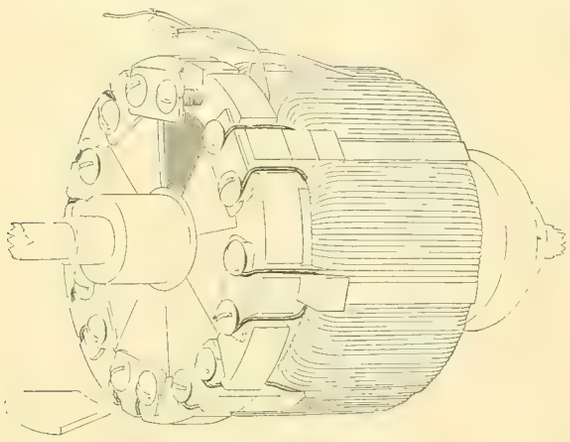


Fig. 3.—Removable Commutator.

the needs of to-day; and more than that, it is fast becoming acknowledged that no ordinary pocket time-piece can be thoroughly depended upon under all circumstances. When every town from New York to San Francisco had its own individual time the variation of a watch was scarcely noticed as it is to-day, when, to prove your watch is right it must be at "standard," or at least an hour away from it. Engineers and conductors know the failings of watches, but the causes which lead to the wild movements of these at times belong to a study which is out of the direct line of railroad education. It is magnetism—that peculiar property which enables iron, steel, and some other metals in a lesser degree, to attract pieces of iron or steel when brought near them. The earth is one huge magnet with a north and a south pole. We find by investigation that nearly all the iron and steel about us is more or less affected—has more or less magnetism resident in it. Pure, soft iron retains but a very minute quantity of magnetism, but steel, especially when high tempered, is capable of retaining a much greater quantity of magnetic power. Now the distance which this power is capable of making itself felt is astonishing, and is, so far as we can judge, illimitable. We know that the earth's magnetism is felt from the equator in either direction to the poles, and unfortunately that is as far as we can conveniently measure its striking distance. It is proportioned to its strength.

The ordinary magnetic compass needle, as you all know, in its normal condition lies in a general north and south position. One end of this needle is of north polarity, and the other of south polarity. The end of the needle usually called the north end is in reality the south, or north-seeking end of the needle. When two magnets are brought near each other and permitted free motion, the poles which are of similar names repel, while those of dissimilar names, or polarities, attract. North and north, or south and south, repel; but north and south attract. Magnetism has no weight. The earth's magnetism is simply directive. The most carefully conducted experiments fail to show that a vertical thread sustaining a horizontal magnet is drawn in the least from its perpendicular. There is, however, a peculiarity pertaining to a magnetic needle which is worth mention, and corroborates the theory that the earth's magnetism is the power which holds the needle in its north and south position. If before a needle is magnetized it is accurately balanced, it will rest perfectly level; now no sooner is it made a magnet than the end pointing to the north assumes a lower level than the opposite end, as if it were heavier. This is called the "dip" or "inclination," and is due to the fact that owing to the rotundity of the earth a direct line from Chicago to the north pole would necessarily point a little downward.

You see from this compass action that it is not necessary there should be contact to produce magnetic effect. The statement may appear startling, but I am greatly inclined to the belief that the majority of the watches in the country are to a greater or less degree magnetized. How can I assume and seem so positive of this you may ask. One thing is certain. You may test the statement. I have told you that the opposite poles of two magnets attract while similar poles repel. Every ordinary magnet has a north and a south pole. No matter if no larger than a chip of iron cut off by a dead smooth file, it has polarity. We only need a freely moving magnet to determine the fact. If your watch laid on the table alongside a delicate compass moves the needle either to the right or left, and as the watch is turned horizontally, if it reverses its action on the needle, there is magnetism in the watch.

You can not depend upon the action of your watch when that magnetism is there. Have none of you ever known a case where a good watch did excellent service while the owner was well, and refused after he had been sick awhile to keep as good time as before? I knew such a one, and the baby hadn't tried to clean the watch either. During an illness of some weeks the watch was hung always in one spot, and in one position, and it became so thoroughly magnetized that when it was again worn it lost time so that it was finally sold. But its owner never knew what ailed it. Remaining in one position twenty-four hours a day for several weeks, magnetism had crept into the spring, or the balance, the screws, or the case spring, or something. Perhaps all these parts, for these are all steel, had become permanent magnets, and its conduct was such that its owner never dared depend upon it afterwards.

This effect of magnets, or of magnetic attraction and repulsion, is far more universal than most of us are aware. If you take a small, cheap compass, and hold it down to the rail you are daily running over, or a street-car rail for that matter, the needle will swing round so as to point to the rail. Now move it along the rail. If this lies in a north and south direction you will find that one end of the needle will be attracted by the north end of the rail, while the opposite end will attract the other end of the needle.

If your rail lies in an east and west position, you will find your north and south polarity lie crosswise of the rail, and you will make your needle reverse by changing sides instead of ends.

Try an iron bridge; you will find that there is polarity there. Your locomotive that you thought you were pretty well acquainted with, has a little trick that you had never thought of. Some parts of it you will find magnetic, and you may possibly find, by careful examination, that when it is blowing off steam there is considerable electricity evolved at the safety valve.

Try the stovepipe in the round house or the shop; pass your little compass up the stovepipe and see how it acts. At every joint you will find a change of polarity, probably. You will find it in the line shafting, and in the anvil of the blacksmith's shop, in the vise and in the files. You will find it almost everywhere.

How did it get there, when there has been no contact with anything magnetic? How is the needle held in its normal position? The earth's magnetism does much of it, but not all. And here comes in play a comparatively recent discovery, which has probably done more than anything else to bring this matter to the surface, to aid in explaining the phenomena, and thus suggesting some remedy for this chronic insanity in time-pieces.

Electricity, and magnetism, and heat, and light, are convertible and re-convertible. Where one is, the other may be made manifest.

We shovel coal into the furnace and heat is developed. The energy set free is shown in the pressure of the steam. Admitted to the cylinder, this moves the piston, drives the pulley, runs the dynamo, generates current, by changing magnetism into electricity, and this last shows itself at the lamp as heat and light.

This same current, if we choose, we may carry to a motor, re-convert it into magnetism, and run the motor to turn a lathe, or a planer, or a pump, or a saw.

Now, if we are at any time, or in any place, free from the deleterious influences of these forces — deleterious to our watches — it must be in some place and at some hour where and when we are seldom seen.

When I tell you that as a rule every steel screw at the watch-maker's shop, lying in a drawer in the original package, is a magnet — when every hair-spring with the original wrapper still protecting it, is a magnet — that if you take a package of cambric needles home from the dry-goods house, and drop one lightly on the water so that it will float, it will point north and south, unless it has become polarized crosswise — and the little hair-spring will do the same thing, how can you expect that your watch can escape the general result? When I tell you that every electric light current is surrounded by magnetic whirls, that it is in fact a magnet, that a wire carrying current will show its magnetic power by attracting particles of iron — how will you protect those parts of your watch which are thus constantly threatened?

But you may say, my watch doesn't play me false, I keep too good a watch on it. True. It is necessary. If there is any one thing a man *knows*, it is what time it is.

There is an old saying that every heart has its own troubles — so has every watch owner. I presume there are no such engineers nowadays, but I have known engine and train men in former times, who daily compared watches with the clock in the "old man's" office, and swore they were right with it; but they often lingered in the hall outside the door just about long enough to set a minute hand, before going down stairs.

It is sometimes quite amusing to start the question of time in a crowd. Usually there are as many different reports as there are watches, and every owner is dead sure his is the right time.

That sort of time answers very well for a crowd

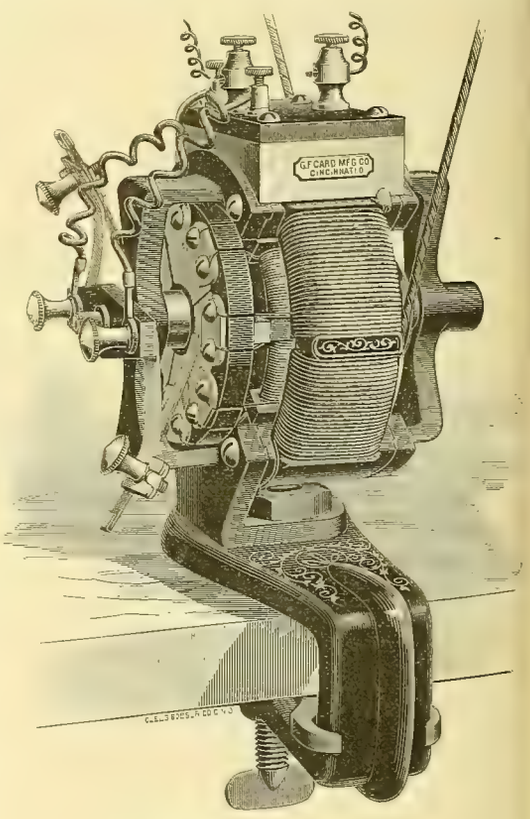
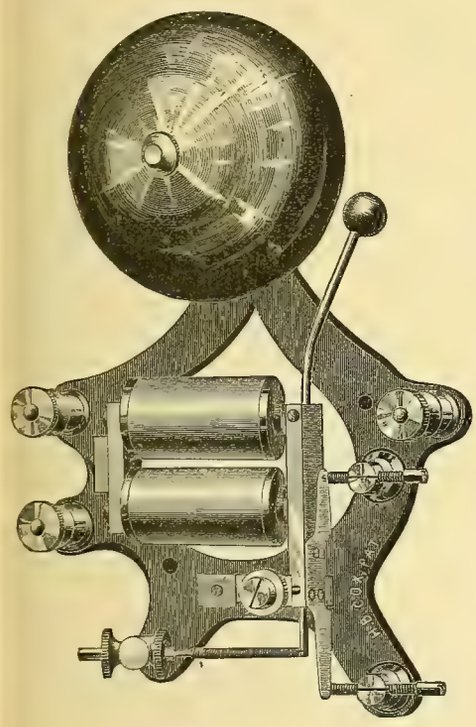


Fig. 2.—Motor for Arc Circuits.

on a street corner, or the people who wait to see the train go by a village station; but for the man in the blouse, whose hand is on the throttle lever, something more reliable is necessary. His responsibility is one of too proud a nature, too serious a character, for trifling or uncertainty.

To return. Having shown pretty clearly, as it seems to me, that watches do become mag-

netic, a word or two of how this affects the rating of their movements. You all know the advantage which a direct application of power has over an indirect one. In the daily walk of life your magnetic watch changes position relative to the magnetic attraction of the earth—what we call the "lines of force"—many times a minute. The balance-wheel, when your engine is running in a given direction, is playing in the plane of these rays of magnetism. You strike a curve, right or left, and your balance-wheel cuts these lines of force, these magnetic rays, at an angle. Another curve and another—railroads are never perfectly straight except on maps—and at each successive change a different angle, and consequently a different strength, is exerted by these lines of force. Sometimes they may increase the sweep of the balance in one direction, but taken as a whole they retard it. Their action is the equivalent of a drag on the wheel, a friction—a brake if you please—to slow up its action. Now, a watch so affected on an engine is surrounded by metal for which a magnet has a decided attraction, and a large part of the iron of the locomotive, save where heat destroys it, is magnetic. Can it be otherwise than that an engineer's or a fireman's watch should be more or less affected?



A Repeating Bell.

Another fact relative to the readiness with which iron or steel may become affected you may be interested in, and you may very easily prove or disprove this by experiment. If you will hold a bar of iron in a north and south line, and strike the end smartly with a hammer, you will find you have made a magnet of it. Now if you reverse it, and strike its other end, you will have changed its polarity. That which was its north end is now its south extremity. Striking the bar jars the molecules of the metal and permits of their more readily grouping or arranging themselves in magnetic form, or of accepting and retaining the magnetic condition, and these jars and blows are always present in your work. Friction, too, and other causes, may produce the same results.

The question naturally arises, What can be done to remedy this evil? Prevention is better than cure, the doctors tell us, and if there could be some way discovered by which this watch blight could be prevented from getting in, there would be no need of devising ways and means by which to get it out.

This question, "How can I bar magnetism out of the balance and spring of the watch?" presented itself very forcibly to C. A. Paillard, an adjuster of watches residing in Geneva, Switzerland, who originally conceived the idea of leaving out that part of the watch which was so constantly causing trouble, and substituting something which would do its proper work without interfering with its regular duties. At first thought it does not seem that this should be extremely difficult of accomplishment; but when we stop to consider that ordinary watches beat five times per second, three hundred times per minute, eighteen thousand times per hour, and four hundred and thirty-two thousand times per day, without stops, and that an error of the one-thousandth part of each of these vibrations would amount to about ninety seconds in twenty-four hours, it really begins to appear something of a task to compass all the needs of the little balance and its delicate partner, the threadlike coil, that is in such constant motion, back and forth, during minutes, days, weeks, years, with such patient, plodding regularity. What are the necessary qualifications in the substitute metal? It must be non-magnetic. It must be of a non-oxidable character, and must not rust. It must be as permanently elastic as steel. It must be capable of adjustment for heat and cold.

Mr. Paillard for a long period was to all appearances battling with fate, as no simple metal possessed all these necessary qualifications. Metals possessing one necessary peculiarity were lacking in one or more equally important particulars, and it was not until that patient experimenter had hit upon his present alloy that perfect success crowned his hopes and endeavors. Mr. Paillard informs us that not until he had experimented for some fourteen years did he arrive at a satisfactory substitute for the metals ordinarily used for balances and springs.

The most satisfactory result was at last reached. Mr. Paillard produced an alloy of palladium, which fully met all requirements. Palladium is a metal only known since 1803, when it was discovered by Wollaston. It weighs a trifle more than half as much as gold—the alloy having a specific gravity of 8.5 while that of steel is 7.7.

In the formation of the balance Mr. Paillard accomplished the compensation by the use of two different alloys of palladium having unlike co-efficients of expansion. This enabled him to more thoroughly unite the two portions of the balance, as a weld is far more perfect between sections of the same metal than between those of dissimilar metals.

The claims of Mr. Paillard seem well authenticated, and are endorsed by competent authority, such, for instance, as a gold medal and favorable report of the jury at the National Exhibition of Watch-making at Besançon, France; Haswell, the sea chronometer constructor of London; Leroy, chronometer maker for the French navy, Paris; and Kullberg, of London. American scientists are also found among the endorsers, prominently among them, Thos. A. Edison, Professor Elihu Thompson, Lieut. F. W. Toppan, U. S. N., Professors Osborn, Loomis, and many others.

Watches embracing these inventions are manufactured and handled exclusively by the Geneva Non-Magnetic Watch company, of New York, and are so thoroughly devoid of magnetic affinity that they may be placed on the strongest electria-light dynamo without in the least affecting their rate of movement.

The future endorsing the past, Mr. Paillard will certainly have conferred upon the railroad fraternity, as well as the rest of mankind, a great and priceless boon.

A Repeating Bell.

As its name implies this bell automatically retransmits or repeats its signal. The accompanying cut clearly shows its construction. The bell is the invention of H. B. Cox, a Cincinnati electrician, several of whose inventions have been illustrated in these columns. The object of this invention is to supply a bell which will, without the use of additional batteries, repeat the signal to a more distant bell or back to a bell located at the signaling station.

For electric bell work this is a valuable addition and will be appreciated, especially in its application as a bell repeating its signal back to the signaling station.

With the ordinary push button battery and bell arrangement, the person pushing the button must take it for granted that the line is in working order and that the bell has sounded. This uncertainty may be overcome by placing at the distant station a repeating bell and near the push button an ordinary electric bell. Then when the button is pushed there is no uncertainty regarding the condition of the line or as to whether the distant bell is ringing, as the bell near the push button will ring and continue to do so just as long as the distant bell rings. When one circuit is closed the other is open and *vice versa*, the push button being the circuit-closer for the repeating or distant bell circuit and that bell acting as circuit-closer for the circuit in which is the small bell placed by the button. Only one battery is used to operate both bells.

The Electric Light and Telephone Under Water.

A novel application of electricity is shown in *Cassell's Family Magazine*. The illustration in connection is self-explanatory. A diver's helmet is provided with an incandescent lamp of fifty candle power and a telephone is also fixed to the inside of the helmet which enables the diver to communicate with his assistants. A modification of this helmet has been devised for the use of men entering gas holders, or for distillery men and firemen. The heavy gear is dispensed with, and replaced by a mouth piece and eye-guard. The mouthpiece has a valve and tube by which the exhaled air is liberated and the pure air admitted for inhalation. The muscular power of

the wearer is sufficient to draw the fresh air through the tube, and no pump is required. Of course the outer end of the tube is in a pure atmosphere.

Electro-Plating Flowers.

A French company has developed a process for electro-plating delicate organic bodies such as flowers and insects. It consists in the employment of an albuminous liquid, with which the different substances in question are treated to prepare them for metallization. This liquid may be thus obtained: A quantity of snails or slugs are first washed in ordinary water to free them from all earthy or calcareous matter. They are then placed in a vessel containing distilled water, and are left here sufficient time to give off their albuminous matter. The albumen thus obtained is filtered and boiled about an hour. After the boiling is added a quantity of distilled water, sufficient to replace that lost by boiling, and about three per cent. of nitrate of silver. This liquid is then placed in bottles, hermetically closed, and kept in the dark. It will thus keep without any alteration. To use this liquid for the preparation of the objects, about thirty grammes of it is dissolved in about 100 grammes of distilled water. In this solution the objects are submerged for a few moments; they are then placed in a bath consisting of distilled water with about 20 per cent. of nitrate of silver in solution, and afterward submitted to the action of sulphuretted hydrogen gas, to reduce the nitrate of silver adhering to the albumen covered surface of the object. Thus treated, all organic matter is rendered fit to receive a galvanic deposit, and the galvanic products obtained by this process are far superior in fineness and neatness to those obtained by any other known process. Even the finest and most minute fibers and veins, the smallest unevenness of surface, and hairs scarcely visible to the naked eye are clearly discernible, and come out with great neatness, the metallic deposit being of perfectly uniform thickness and adherence.

Tachometers and Tachographs.

By F. B. Badt.

It is often of great importance to know exactly the number of rotations of an engine or a dynamo in a given time, as, for instance, when calculating the horse power of an engine or the efficiency of dynamos or lamps. Complaints are often made by the buyers of electric light plants that the electric lights do not give satisfaction; that they burn unsteadily or that the incandescent lamps

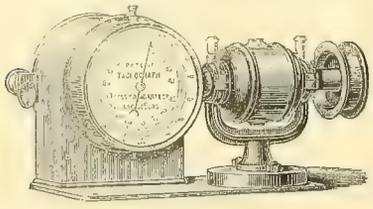


Fig. 1.

are short-lived. Ninety-nine per cent. of these complaints have their origin in unsatisfactory motive powers where insufficient or no investigations at all were made to ascertain the variations in speed of the motive power. The usual way of ascertaining the speed of machinery is by the use of a watch with a second hand and by a speed indicator, the spindle of which receives its motion by being pressed into the center hole in the end of the revolving shaft. Usually the revolutions are thus counted for a minute. The results of this kind of measurements are more or less unsatisfactory from the following causes:

First, Fault in timing. It is very difficult to start and stop the indicator exactly at the beginning or the end of a minute.

Secondly, Slipping of the point of the indicator in the shaft.

Thirdly, The speed of the revolving shaft may vary several times within a minute. Repeated measurements may give about the same result and still the motion may not be uniform.

Fourthly, The speed within fractions of a minute can not be measured with any accuracy at all.

The exact number of rotations in a given time can only be determined by special sensitive apparatus constructed for the purpose. These instruments are called tachometers, when they simply indicate the number of rotations, and tachographs when they indicate and record the variations of speed in a similar way as the variations in pressure of steam boilers are recorded on bands of paper by the Edson or other self-recording steam gauges.

Tachometers are made either for portable or for stationary use. When portable they are provided with a three-cornered steel spindle which is pressed against the rotating shaft; when sta-

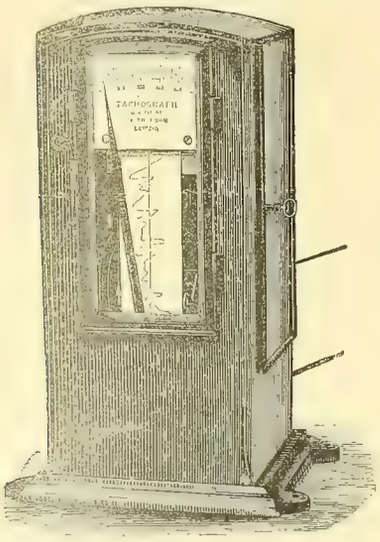


Fig. 4.

tionary they are connected to the shaft by means of a small belt, or better by means of toothed wheels. They indicate at all times on the dial the exact speed. Any variations of speed in the smallest fraction of a second can be easily detected and the slipping of a belt will show at once. There are two classes of tachometers; one which employs the principle of centrifugal force and the other which uses magnetic and electric forces. To the first class belong the tachometers of Buss, Sombart & Co. Magdeburg and Jacquemier, Paris. There is also an instrument made on this principle by N. P. Bowsher of South Bend, Ind., which is largely used in mills, especially on water power. Its indications are sufficiently correct for such purposes. To the second class belong the instruments of Mariel Deprez, Paris, and Dr. Th. Horn, Leipzig. A brief description of the best representatives of the two classes is appended:

1. Tachometer and tachograph of Buss, Sombart & Co. Magdeburg:—It is possible with this tachometer to read at any moment the rate of rotations per minute then going on, from a pointer moving on a scale. The position of the pointer is regulated by a spring which acts like a centrifugal pendulum. The spring is in a cylindrical iron case. The tachograph is a tachometer which records the indications on a continuous band of paper in the shape of a curve. Clockwork can unroll the paper tape at a speed of one-fifth, two-fifths or four-fifths of a minute as may be desired. The motion of the paper band can be stopped at any instant without stopping the indications The readings can be taken very easily. The instrument is compact and strong and can not be interfered with by vibrations or shocks. The whole is inclosed to keep out dust

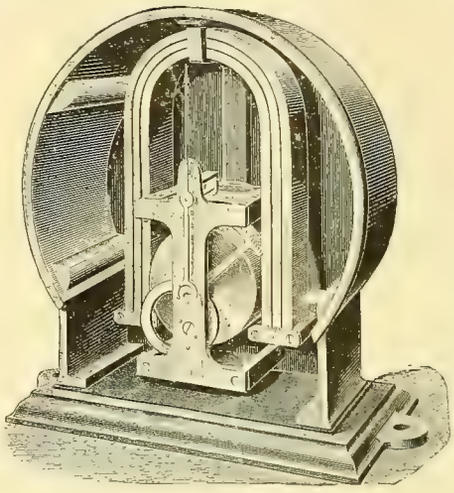


Fig. 3.

and moisture. The few bearings which need oil can be lubricated from the outside.

Figs. 1 and 2 show views of the tachograph front and back.

The tachometer is constructed like the tachograph, except that it has no recording apparatus. For larger electric light installations and for electrical experts, this instrument will be found of great value.

2. Tachometer and tachograph of Dr. Th. Horn, Leipzig:—Fig. 3 shows the inside of the tachometer. This instrument is based upon Arago's experiment. A magnetic needle suspended over a copper disk, revolving on a vertical axis is deflected in the sense of the rotation. The velocity per minute will be in a certain ratio to the deflection of the needle. To make this device a practical speed indicator the weak earth magnetism is replaced by the field of a strong steel magnet, the needle by an old fashioned Siemens I armature of soft iron which can revolve between the poles of the magnets. The copper disk is replaced by a strong copper capsule which rotates between the poles of the magnet and around the armature. The Foucault currents in the copper capsules will be proportional to the velocity of rotation and the intensity of the field. And since the magnetic moments with which the armature is drawn back to its normal position are nearly proportional to the angles of deflection—at least from zero up to about 40 degrees—the deflections of the needle will be proportional to the speed.

Dr. Horn claims that small variations in the intensity of the magnetic field will not influence the indications of the instrument. He reasons thus: Suppose the magnet is composed of two laminæ. In taking away one, we not only reduce the intensity of the magnetic field, but also the induced poles of the armature to one-half. As the attraction of the opposite poles of the magnets and armature is proportional to the product of their strength, the magnetic moments with which the armature is drawn back to its normal position are only one-quarter of their former value. The strength of the Foucault currents in the capsules are also reduced to one-half, as is the magnetic field. The product of both is the deflecting force of the rotating capsule, which, of course, is $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$. These forces therefore keep

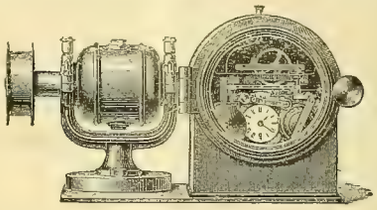


Fig. 2.

up their equilibrium without regard to the strength of the magnetic field. Dr. Horn has verified this theory by experiments. The calibration of these instruments is empirical. Figs. 4 and 5 represent Dr. Horn's tachograph. The paper band has a vertical red line which corresponds with the normal speed. The variations upward to 25 per cent. both ways are marked in the shape of a curve to the right or left of the red line. The movement of the tape is effected by gearing from the shaft, not by clockwork.

Diagram for Electric Wiring.

E. E. Stark, of Cleveland, O., has devised, copyrighted and published a diagram designed to indicate the size of wire appropriate to any given length of circuit, size of current and volt-loss. It shows a set of parabolic curves, all starting from a common source, each one giving the curve of variation for specified distances and volt-loss. It has an upright scale marking thousandths of an inch up to half an inch, with horizontal parallel lines issuing from it and cutting the curves. It has another horizontal scale of ampères, with upright parallel lines also cutting the curves and the lines from the inch scale, all so adjusted that the point where the line from the ampère scale cuts the curve appropriate to the length of circuit and volt-loss, also gives the indicator from the wire gauge for the right size of wire for the given case.

A Subway in Minneapolis.

The Minneapolis city council has recently granted to the National Subway company a franchise to build the Dorsett conduit in that city. The life of the franchise is fixed at thirty years.

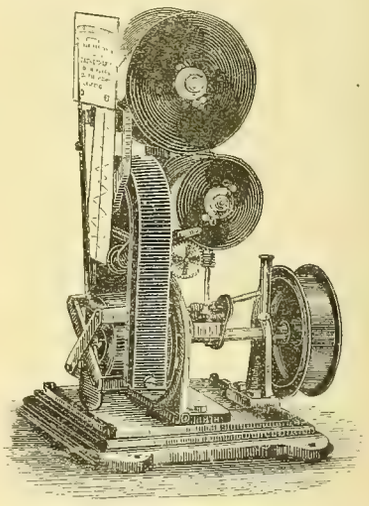


Fig. 5.

A local company will be organized at once, and will become possessed of the franchise granted the National company, and the patents belonging to that company. The National Subway company will do the construction work which involves about ten miles of the system and will begin operations early in the spring.

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number XVI.

The Hochhausen Dynamo, continued.—The apparatus for current regulation is shown in Fig. 47, which is a front sectional view of the dynamo. At the right is shown a small motor, to which is attached gearing connected with the movable circle which carries the brushes, so that any movement of the motor, direct or reverse, changes the position of the brushes on the commutator and varies the magnetic intensity.

The armature of the motor rotates between two pole pieces, connected with the pole pieces *C, C*, of the field magnets by the brackets *h, h*.

At *W* is shown a series of wires, each of which connects with a separate coil of the field magnet *B*, and these are joined at their lower extremities to a series of insulated contacts 26. Another series of wires, W^2, connected with a series of similarly placed coils of the field magnet, B^2, is joined to the interior set of insulated contacts 25. Contacts 25 and 26 being insulated from each other, no electric current can pass between *B* and B^2 till electric connection is made between 25 and 26; this is done by two copper brushes attached to the little plate, fixed on the outer end of the movable arm, 27, which is attached to the motor, and moved by it. There are thirteen wires in the series, *W*, though the number is not limited, and when 27 closes contact in wire 1 all the coils of *B* are in circuit with all those of B^2, and the magnetism of the field is at the maximum; but when the motor moves 27 downwards so as to close the contact in any other wire, say number 4, as shown in the cut, the coils at the lower end of *B* and the upper end of B^2 are cut out of the circuit, and the field magnetism proportionally reduced. The brushes are, at the same time, rotated on the commutator by the gearing, and made to recede from the line of greatest magnetic intensity, so that the volume of electric current is reduced from both causes.

The apparatus for operating the motor is shown above the wires *W*, and differs considerably from the apparatus in actual use, while preserving its essential features. The wires connected with the motor brushes at *m*, m^2, connect above with branch wires leading to two equal carbon resistances, *R*, R^2, at the right, and at the left with two contact points placed one above the other on the vertical arm of a compound lever; and *R* R^2 are connected together by a wire, as shown. The two separate parts of the compound lever are hinged on separate brackets, as shown, and the upper part, which acts as an armature, is hinged at its angle, *n*, and has a vertical arm and also a horizontal arm, *N*. Connected with the inner end of the arm *N* is a spiral spring, not shown, by which it is drawn down in opposition to the magnetic attraction of the upper plate B^2 of magnet *B*.

When the electric current is at its normal volume, the magnetic attraction, acting against the spring, is just sufficient to keep the vertical arm of the armature in contact with both contact points; the lower arm being composed of two bars insulated from each other and a contact point attached to each. The motor, with its connections, is placed in the electric circuit, the terminals of which are shown at 5 and 6. Hence, when the current is at its normal strength, and both points of the lever are in contact, the current from 5 divides at the contact points and currents flow through the two branches, one through *R* and the other through R^2 to 6, and both being of equal potential and encountering equal resistances, there is no current through the motor. But if from a reduction of resistance in the lamp circuit there occurs an increase of current in the field magnet coils, and consequently of magnetic attraction, the armature *N* is attracted upwards by B^2, the vertical arm connected with it moved inwards at its lower extremity, the upper contact opened while the lower one remains closed; hence, the current from 5 flows through the lower contact and divides, one part flowing through *R* to 6, while the other part flows to *M*, motor brush *L*, through the motor to brush L^2, thence by m^2 and resistance R^2 to 6; the armature of the motor rotates, moving the circuit closer 27, which is attached to it, downwards, and cutting out a sufficient number of coils to reduce the current to its normal volume. This reduction is aided by the movement of the dynamo brushes, which are, at the same time, made to recede from the line of maximum intensity, as already explained.

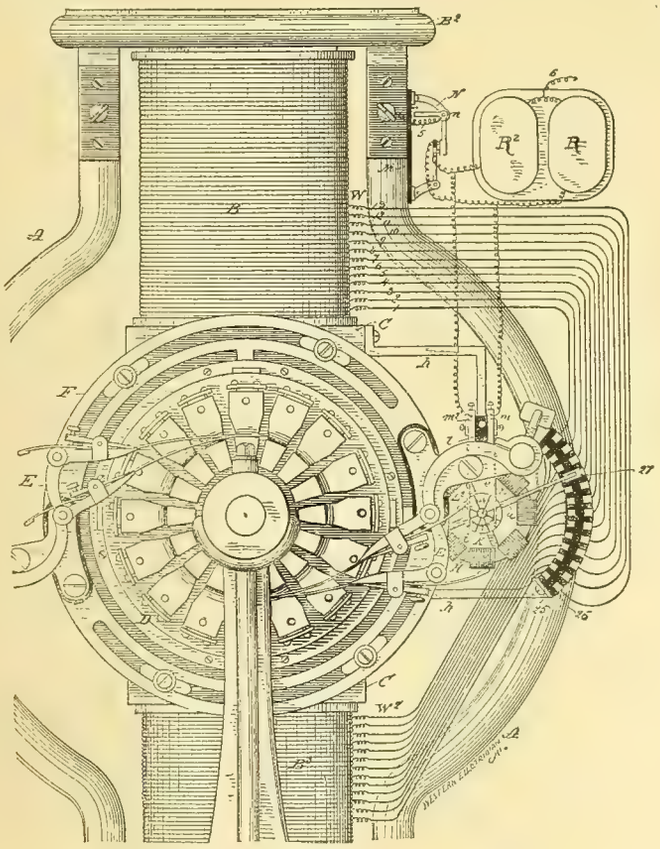


Fig. 47.

If from an increase of resistance in the lamp circuit the current is abnormally decreased, the magnetic attraction on the armature becomes reduced, and the armature drawn down by the retractile force of the spring, this opens the lower contact, the upper one remaining closed, and reverses the motor current; the current from 5 flowing through the upper contact, dividing as before, one part flowing through R^2 to 6, and the other part through m^2, motor brush L^2, through the motor to brush *L*, thence

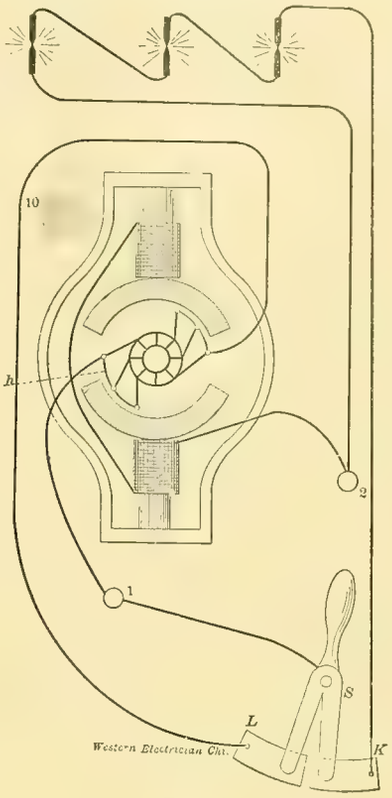


Fig. 48.

by *m* and resistance *R* to 6. The action of the motor is, consequently, reversed, the circuit closer 27 moved upwards, and the current increased to its normal volume by this action, aided by the approach of the dynamo brushes to the line of maximum intensity.

The amount of current flowing through the motor depends on the resistances, *R*, R^2, and varies in the same ratio, and, hence, can be increased or diminished to any required extent. These resistances should be equal, so that the volume of current passing through the motor in either direction may be the same. In the improved current regulator carbon rods are used instead of carbon plates, and the lever vibrates between the contact points; being out of contact when current on the motor is not required. The apparatus is inclosed in two neat cases attached to the right side of the dynamo, as shown in Fig. 43, Number XV.

The short circuiting switch is an apparatus for throwing the current off or on the lamp circuit as required, and will be readily understood from Fig. 48. Its special object is to prevent injurious effects from the extra current on opening the circuit. This current, which flows through the circuit at the moment the connection is broken, has, as is well known, exceptionally great energy, and is often the cause of accidents to the dynamo or attendants. The cut shows a dynamo and lamp circuit with contacts *L* and *K*, a forked switch *S*, and a short circuit by which the current can be diverted from the lamp circuit. When both arms of the switch rest on contact *K* the full current flows through the lamp circuit, but when both rest on *L* the lamp circuit is cut out, and the dynamo short circuited through wire 10. But when an arm rests on each contact, as shown, the current is divided between the two circuits, contact being made with the short circuit before it is broken with the lamp circuit; the switch can then be moved so that both arms shall rest on contact *L*, and the lamp circuit be cut out without danger from an excess of current.

At a meeting of the board of managers of the Chicago Electric club last week, six additional managers were elected as follows: E. B. Chandler, Col. Geo. L. Beetle, H. Ward Leonard, F. W. Cushing, Geo. H. Bliss and S. A. Treat.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome, and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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THE Chicago Board of Trade will run a ticker plant of its own, substituting it for its telegraph plant with which it has been supplying quotation to the telegraph companies. This is another move to checkmate the bucket shops, one of whom tapped the telegraph wire that carried the quotation, in the cellar of the Board of Trade building. The president of the board admits that it is almost impossible to protect quotations from being stolen as long as they are transmitted on a telegraph wire, but he hopes that when the ticker plant is put in use the quotations will not be pilfered.

THE process of electro-plating flowers and insects, described elsewhere, will be read with interest, and may prove a valuable addition to the many similar processes in use. Thirty-five years ago, when electro-plating for any purpose was merely in the experimental stage, there was a very valuable collection of beetles, in a college cabinet, obtained from all parts of the world at great expense, in which decay had just begun its insidious development; five years ago, only a small remnant of that splendid collection remained. Now, by one of the numerous electroplating processes, such a collection can be preserved in its beauty and freshness for an indefinite time.

STRICT accuracy is one of the beauties of science, and in no department of science is this of greater importance than in electric measurement; hence the article on tachometers and tachographs by Professor Badt, which we give in this issue, will interest our readers, especially as the writer is a practical electrician, and his opinions are the result of daily practical observation and experience in electric lighting.

All instruments of the kind mentioned should, if possible, be entirely automatic, and the variations in time which must occur where the results depend in part on observation by the operator detract seriously from the value of the instrument and in measurements requiring extreme accuracy may render such instruments practically worthless.

The instruments described are controlled as all instruments for electric measurement should be, electrically and magnetically, and not in part mechanically; and hence their indications are derived from the electric and magnetic moments resulting from the speed of the machinery, which is exactly the object to be attained.

THE executive committee of the National Electric Light association have addressed a circular letter to the members asking for subscriptions to a fund to meet the expenses of printing the report of the proceedings of the conventions held in Detroit, Philadelphia and Boston, and the expenses of presenting the bill to the fiftieth congress providing for the creation by congress of a commission to revise the present patent laws and correct existing defects. The approximate amount for the first purpose is set at $1,000 and for the second $1,500. Both the objects are meritorious and the appeal should receive immediate and ample response.

The patent bill is the outcome of the deliberations of men most intimate with the workings of the patent office, its defects and its needs. The measure is as conservative as could be desired. It is designed simply to set in motion the legal machinery which will work out a better system than now prevails. It calls for the appointment of a commission to revise the laws and the patent system. Particularly to men engaged in the electrical field, at present the most active of any of the departments of art or science, are the measures aimed at in this patent bill of vital importance, and those men should be the ones to respond promptly and liberally to the call for funds to assist the committee in presenting the bill to congress.

A NEW phase is put upon the matter of the concessions in China, concerning which considerable has been published in this journal, by the interview with Mr. Rae which appears elsewhere. When the news was first published of the important concession made by China to a syndicate of American capitalists, it was received with some incredulity, especially when the record of the active agent in the enterprise, Count Mitkiewicz, was looked into. Columns upon columns of the daily press were devoted to his alleged misdeeds for a number of years. But there was convincing proof that the concessions had been granted and their value was self-evident. The next step was taken by German and English diplomats to nullify the accomplishments of the Americans. Then it was announced that the state department at Washington, had been quietly investigating the concessions and, if necessary, would use its influence towards protecting the Americans from the detracting influence of disgruntled foreign diplomats. It seems that the Americans are still and are likely to remain in possession of very valuable concessions.

In the interview reference is made to the outlook for the employment of telegraph and telephone operators at highly remunerative wages in China. Mr. Rae's statement, based upon his experience and observation, is worthy of the consideration of those operators who have been dazzled by promises of high wages emanating from a source that can not be recognized.

PROFESSOR BARRETT'S idea of a portable electric light for use at fires will strike firemen as a highly commendable one, and they will await its first trial with interest. To the man whose experience with fires calling for the services of a fire department is limited to the descriptions he reads in newspapers, the usefulness of the apparatus will not be evident and, in fact, his extremely limited experience might pronounce the scheme an unwarranted and useless expenditure of money. But let that man turn out at midnight and run to a fire on some of the streets in Chicago devoted to warehouses. At best the streets are but faintly illuminated by gas, and as he stumbles along he will undoubtedly learn more about the illumination of Chicago streets than he ever knew before. He arrives at the fire and finds puffing steam engines, lines of hose, hook and ladder trucks and chemical extinguishers, surrounded by a crowd of firemen, whose lamps only indicate the outlines of a huge warehouse, which may have within its bosom a raging furnace, that threatens destruction internally, while externally there is no visible sign of the conflagration inside. A ladder is raised to an upper story but it can not always be placed advantageously for the upper end is away up in the darkness of the night, and priceless time is lost while a man hastily mounts to discover where that other end leads to, whether to a convenient place to gain access to a window, or whether to the blank wall between two windows. Again the location of the fire may be on some dark alley which is not illuminated at all, and where the firemen risk their lives in driving their horses. There is no question but that the apparatus will prove its usefulness particularly in a city which still clings to its old method of lighting by gas.

THE article on the cost of domestic electric lighting in England, by Sir David Salomons, furnishes interesting and valuable data, and there are many ways in which these estimates, which have evidently been very carefully made, may be turned to good account by electric lighting companies and others. Some of our large business houses in this city found it far more economical, even in the earlier stages of electric lighting, five years ago, to install isolated plants than to use gas. One of the first men to use the electric light here said to the writer at that time that he would not change back to gas if it were furnished for nothing; and this was prior to the introduction of the incandescent system. One very pertinent remark will be noticed in the article—"the gas burner does more mischief than the difference in price, without the convenience." The irreparable injury to valuable paintings and costly drapery from the carbon deposit of gas should be taken into account in all estimates of comparative cost. Five years ago, before electric lighting had come into general use, the damage to paintings from gas in the Paris art galleries was becoming a matter of serious consideration.

The increased annual expense of cleaning walls and ceilings, and renewing paper hangings, is also a considerable item to be added to the cost of gas in domestic lighting. It is a fair assumption that paper hangings require renewal at least twice as often with gas in use as with the incandescent electric light, making a difference of 50 per cent. or more in this item alone in comparative estimates.

In cities and towns the storage battery, charged from central stations, bids fair to solve this problem of domestic lighting. During the present year many private residences in our cities have been lighted in this way; and it is to be hoped that the time is at hand when, by the use of improved batteries, the cost of this beautiful light will be so reduced as to be available in the cottage as well as in the costly mansion.

Two years ago there were three competing telegraph systems between the east and west, and as a consequence rates were comparatively low, ten word messages between Chicago and New York ranging from 15 to 20 cents. Two of these systems are now under the control of a single company, while the third offers only a limited competition, and as a consequence there has been a considerable advance in rates. If this advance is necessary in order that the capital invested shall earn reasonable dividend, then there is no cause of complaint. If, on the other hand, the low rates paid such a dividend, then the advanced rates must be regard as exorbitant. The public are naturally in favor of low rates, and there is a strong and increasing opposition to monopolies. There is also a general impression that telegraphing can be made to pay at moderate rates, and these sentiments find expression in the demand for a public telegraph, owned, managed and controlled by the government, on the same principle as our postal system. The recent transfer of the B. & O. telegraph has renewed the agitation on this subject, which had partially subsided during the prevalence of the cheap rates. Senator Cullom, who strongly favors the scheme, has recently expressed himself very emphatically on the subject of telegraph monopoly, and expressed his opinion that the necessary legislation will be enacted within three months. One thing is very certain, that whether the chief control is public or private, the same men who now equip and operate the lines must still continue to do so; so that there can be no loss to the working force, or to the thinking and inventive brains.

The government telegraph is an established institution abroad, but they are satisfied with a slower service on the other side than would be tolerated here. With the telegraph in the hands of the government the rate would undoubtedly be low, but would the service still remain what it is now, the quickest in the world? It is safe to say that nothing but the quickest attainable service would satisfy the pushing American business man.

The Cost of Domestic Electric Lighting.[1]

By Sir David Salomons.

Part II.

The following table shows cost of installations of various sizes, Otto gas engines being employed as well as steam engines by Messrs. Marshall. Other makers' prices for the same powers do not vary much, and the prices of the manufacturers mentioned are taken as being a fair average. The cost of dynamos of all the best manufacturers do not vary much for equal capacities, and the only accumulators largely used at the present time are those of the Electrical Power Storage company, and Messrs. Elwell-Parker. The goods of both these firms are practically identical in output and price. Other cells exist, but they have not borne the brunt of time, and therefore they must be regarded as being still in the experimental stage, although some may eventually prove better than those above mentioned. In giving prices, a sum has always been added to the bare cost of the article in order to amply cover the cost of carriage anywhere by rail in Great Britain; and also of foundations, any necessary apparatus, such as gas meters, taps, pipes, belting, and main switches, and the cost of fitting up generally. The lamps are assumed to be 16 candle power incandescent, or if 8 candle power, then double the number are allowed:

Installations without an Accumulator.

Gas Engines.

No. of Lamps.	Cost of Dynamo, Fixing, &c. £	n. h. p.	i. h. p.	Cost of Engine, Fixing, &c. £	Wires and Lamps. £	Total. £
25	50	2	4	170	50	270
40	60	3½	6	210	80	350
50	70	4	8	220	100	390
90	105	7	14	260	180	545

No doubt the engines would run more lamps, but the work then imposed would be advancing nearer the limit of capacity of the machines than is desirable. This remark applies also to the following tables:

Davey Motors.

No. of Lamps.	Cost of Dynamo, Fixing, &c. £	Actual h. p.	Cost of Engine. £	Wires and Lamps. £	Total. £
25	50	3	120*	50	220
50	70	6	220†	100	390
80	100	10	300†	160	560

* This engine requires continual attention.
† These engines have hopper boilers and need attention every eight hours.

Steam Engines.

No. of Lamps.	Cost of Dynamo, Fixing, &c. £	n. h. p.	Cost of Engine, Boiler, Fixing, &c. £	Wires, Lamps, &c. £	Total. £
45	65	3	220	90	375
60	75	4	250	120	445
90	105	6	310	180	595
120	125	8	350	240	715

In all cases of the last table there is a large margin of power given to allow for variations in the pressure of the steam in the boiler. It is considered that £2 per lamp will fairly cover wiring a house in a first class manner—provided the engine shed is near the dwelling to be lighted—including lamps, lamp-holders, switches and fuses, and also fittings of a simple kind. More elaborate fittings must be regarded as luxuries, and need not here be considered, since no limit to price can be fixed in this direction. Thus we we see the average cost per lamp, in the installations given, works out as follows:

For Gas Engines.

No. of Lamps	Average cost per lamp, approximately. £	No. of Lamps.	Average cost per lamp, approximately. £
25	11	50	8
40	9	90	6

For Davey Motors.

25	9	80	7
50	8		

For Steam Engines.

45	8	90	6.10
60	7.10	120	6

So much for the initial cost of simple installations. When an accumulator is employed extra expense is involved by the cost of cells, shelves, some extra switches, and probably automatic switches and governor. In practice it is not convenient to have an accumulator which will supply more than about eighty 16 candle power lamps at one time on account of the extra weight of the cells and the expense. It may fairly be allowed that the switch boards required when an accumulator is used will cost about £40 for any number of lamps up to fifty, and £60 for fifty to 150 lamps with measuring instruments, all of the best make and design. The price given for the accumulator includes shelves, connections, labor for putting up, and carriage. Simple electrical governors—not on the engine—cost, when fixed complete, about £15, and and a thoroughly complete set of governors about £70 to £100. In addition, automatic switches cost some £30. Lamps work with currents at different pressures, the most common in use being those of 60 volts and 100 volts. An accumulator giving 60 volts for a maximum of thirty lamps alight at a time for eight to ten hours, or proportionately longer for a less number of lamps, costs about £110, including carriage and shelves. An accumulator for 100 volts suitable for a maximum of fifty lamps alight at one time for eight to ten hours, complete, costs about £200; and one for 100 volts to light a maximum of seventy to seventy-five lamps for eight to ten hours costs, complete, approximately £300.

Installations with an Accumulator.

With Gas Engine.

No. of Lamps.	Cost without Accumulator. £	Accumulator and Switch Board, and One Governor. £	Best method. Accumulator, Switch Board and Governors, and Automatic Switches. £
25	270	415	515
40	350	605	705
50	390	665	765
90	545	920	1050
With Steam Engine.			
45	375	630	730
60	445	720	850
90	595	970	1100
120	715	1090	1220

In all cases the cost of the engine and accumulator house is neglected, since a building suitable for this purpose often exists, and where it does not, 4 pence to 6 pence per cubic foot capacity will amply cover the expense, the higher price being for a more substantial building. Thus an installation of 90 lamps with an accumulator could be housed in a room 60 feet by 20 feet, and 12 feet average height, with a division to separate the cells from the machinery, and the cost of this at 6 pence per cubic foot would be £360. From the above tables an approximate average of the initial cost per lamp with an accumulator are given in the following:

No. of Lamps.	With Gas Engine and Accumulator. £	Best method. £
25	17	21
40	14	18
50	13	15
90	10	12

No. of Lamps.	With Steam Engine.	Best method.
45	13	16
60	12	14
90	11	12
120	9	10

Now for working expenses. A gas engine requires about 20 cubic feet of gas per hour per i.h.p., and 30 cubic feet per b.h.p. Gas is here taken at 3 shillings 6 pence per 1,000 cubic feet. For oil and waste 2 pence an hour should be allowed. Lamps at present cost 5 shillings each, whether 16 or 8 candle power, and are expected to last 1,000 hours. The number of hours after sunset to 11 p.m. and from 6 a.m. to sunrise for the whole year amount to some 2,075, say roughly 2,000 hours. The calculations are made on these data, which practically indicate that the installation is worked all the year round very nearly to its maximum. The sinking fund and interest are taken at 7½ per cent. in simple installations, and 10 per cent. where an accumulator is employed. Attendance is taken at 10 shillings a week in all cases, since the man will not be required to devote more than one half or a third even of his working hours to the installation. Thus we get without accumulator:

Gas Engines.

No. of Lamps.	Gas at 3s.6d. £	Attendance, Waste, Oil, etc. £	Lamps. £ s.	Total. £ s.
25	28	42	12 10	82 10
40	42	42	20 0	104 0
50	56	42	25 0	123 0
90	98	42	45 0	185 0
Steam Engines.				
	Coal.			
45	50	42	22 10	114 10
60	65	42	30 0	137 0
90	100	42	45 0	187 0
120	130	42	60 0	232 0

Coal is taken at £1 per ton delivered, and 6 pounds per hour per i.h.p., with a margin for lighting up.

It is evident at once on comparing these tables that the difference in cost for installing, as well as the working expenses for gas and steam engines, are much the same up to, say, 100 lamps; and since gas engines require less attention, these are to be preferred for small installations, their only drawback is the liability to stoppage. For a large number of lamps the steam engine has every advantage. No interest or sinking fund has been allowed for in the above, for had private gas works been required then the interest and sinking fund on this would counterbalance the other. Had an accumulator been used the expenses would amount to about the same, for although an extra sum must be allowed for the wear and tear of the accumulator, and the loss of 25 to 30 per cent. which must ensue by their use, still the saving is very great in another way, since the engine need not be run when very few lamps are alight, and light may always be obtained from 11 p. m. to 6 a. m., so that candles and lamps are quite unnecessary. For cases where private gas works would not be employed the interest on the work must be taken into account as well as a sinking fund. Naturally if the installation is not worked all the year round, and if the maximum number of lamps are not in use daily from 6 a. m. till sunrise, and from sunset till 11 p. m., much of the annual cost is reduced; but again, if most of the lamps are unemployed for a great part of the year the expense per lamp goes up enormously, for we should be paying interest on capital doing no productive work.

Table of Sinking Fund and Interest Approximately.

Gas Engines.

No. of Lamps.	No. Accumulator. 7½ per cent. £	With Accumulator. 10 per cent. £	With Accumulator, Best method. 10 per cent. £
25	20	41	51
40	26	60	70
50	30	66	76
90	40	92	105

Now for total annual expenditure, including sinking fund and interest for gas engine installation:

No. of Lamps.	No. Accumulator. £ s.	With Accumulator. £ s.	With Accumulator, Best method. £ s.
25	102 10	123 10	133 10
40	130 0	164 0	174 0
50	153 0	189 0	199 0
90	225 0	277 0	290 0

Average Cost per Lamp a Year.

	£ s. d.	£ s. d.	£ s. d.
25	4 0 0	5 0 0	5 7 0
40	3 2 0	4 2 0	4 7 0
50	3 0 0	3 16 0	4 0 0
90	2 10 0	3 1 0	3 4 0

Table of Sinking Fund and Interest, Approximately.

Steam Engines.

No. of Lamps.	No. Accumulator. 7½ per cent. £	With Accumulator. 10 per cent. £	With Accumulator, Best method. 10 per cent. £
45	27	63	73
60	33	72	85
90	45	97	110
120	53	109	122

Total Cost per Annum, including Sinking Fund, Interest, and Working Expenses.

	£ s.	£ s.	£ s.
45	141 10	177 10	187 10
60	170 0	209 0	222 0
90	232 0	284 0	297 0
120	285 0	341 0	354 0

Average Cost Per Lamp a Year.

	£ s. d.	£ s. d.	£ s. d.
45	3 2 0	4 0 0	4 4 0
60	2 17 0	3 10 0	3 13 0
90	2 11 0	3 3 0	3 6 0
120	2 9 0	2 16 0	3 0 0

These results no doubt prove far better than those attained by the average cost of gas with a private gas works under similar conditions, since to the latter must also be added the cost of many lamps and candles, which are indispensable where gas is in use. If the owner of an installation neglects the interest on his capital, which is generally the case, 2½ per cent. is ample for a sinking fund with no accumulator, and 5 per cent. if one is used. Take, for instance, an installation of 90 lamps, worked with a steam engine and accumulator with the best appliances, then the total annual cost will be about £3. 6s.

[1] From *Industries*, October 7th.

per lamp if used 2,000 hours and since the best methods of regulation allow a lamp in most instances to last 2,000 hours, double its life, as here assumed, £3 should be ample. Compare this with a gas burner giving an equal amount of light. A 6 ft. burner is about the equivalent, and if the price of gas is 3 shilling 6 pence per 1000 cubic feet, then for 2,000 hours the cost will be £2. 2s. With the electric light interest and other items were taken into account; we must, therefore, do so in this case. Probably pipes and fittings per gas burner in most cases may be taken at an average of £3 per burner, say only 5 per cent. for interest and sinking fund, then each burner will cost annually £2. 5s. Then candles and lamps will probably not cost less than 2 shilling a year for every burner in a house, that is, in a house with 50 gas jets, at least £5 would be paid for oils and candles besides; this brings up the total to £2. 7s, against £3 for the very best method of lighting by electricity; and it need hardly be pointed out that a gas burner does more mischief than the difference in price, without the convenience. For a large installation of 150 lamps and over, the cost rapidly becomes less than in a case of gas. The reason why 25 to 120 light installations have been chosen for examples is, because in the majority of houses 25 lights are the number mostly in use, and in a large country house it is rare that more than 120 are required at one time. The maximum lighting power of the installation does not prevent more lamps being set up, but the number in use at one time must not exceed the maximum capabilities of the machinery or accumulator. It has not been thought worth while to give the bare cost of the engines, dynamos, &c., since these are easily arrived at by consulting the makers' price lists.

Before concluding, it may be well to give a practical example taken from the Broomhill installation. The cost of one part of it capable of lighting 200 16 candle power lamps with ease, with accumulators for 150 lamps at a time for ten to twelve hours, perfect governors and every part of the installation absolutely automatic, has reached some £2,000. [The total cost has been approximately £6,000, but this is for a duplicate arrangement, extra dynamos, experimental apparatus, motors, and other items.] Therefore, the inital cost has been £10 per lamp. Sinking fund and interest is placed at £200 a year, the whole time of a good engine driver £75 a year, oil, waste, and repairs £25 annually. The coal consumed all the year round, that is for 2,000 hours, and always for 150 lamps, comes to 2 hundredweight an hour, or a total of £200. The coal actually costs 18 shilling 6 pence to 19 shilling a ton, delivery extra. Hence the total expense for 150 lamps per 2,000 hours is £500, but to this must be added boiler insurance £10, and the cost of 150 lamps; making an addition of £47. 10s., say 50 with carriage and other incidental expenses, in all, therefore, £550. The governing arrangements permit the life of each lamp to exceed 2,000 hours. Thus the yearly cost per lamp is £3. 13s. But in practice so many lamps are rarely used at once, nor is the installation used all the year round; a saving is thus exercised which has rendered the electric light really far cheaper than if gas had been employed as a source of illumination.—*Concluded.*

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	390
Central Union	44	45
Michigan	73	74
Great Southern	28	30
Colorado	18	20
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	157	160
Iowa Union	25	27
Missouri and Kansas	69	70

Last season an amusement manager of Cincinnati attached an electric wire to chairs in the auditorium during an electric exhibition, and gave each occupant a shock, including one who now brings suit to recover $10,000 damages.

That Telephone Concession in China.

In the party of Americans who returned from China a few months ago bearing with them important concessions from the Chinese government in favor of a syndicate composed of American capitalists, with Wharton Barker, of Philadelphia, at the head, were two electricians, E. T. Barberie, of New York, and Frank B. Rae, who has recently assumed temporarily an important position with the Gold & Stock Telegraph company, of Chicago. Mr. Rae, in a chat with a WESTERN ELECTRICIAN representative a few days ago, threw additional light on the importance of the concessions, and gave some interesting information in regard to the present status of telegraph and telephone lines in China.

The WESTERN ELECTRICIAN has given the main features of the concessions which granted rights to establish a bank with 50,000,000 taels capital, and, as well, rights to construct railways and build telephone and telegraph lines. Note has also been made of facts in the career of Count Eugene de Mitkiewicz, who served as a diplomat and was instrumental in securing the concessions to American capitalists.

Mr. Barberie and Mr. Rae accompanied the expedition as electricians to study the ground and possibly, if it became necessary, to erect an electric light plant in one of the palaces or perform any electrical work needed to further the ends of the petitioners for favor. However, demonstrations of any kind were uncalled for, and the gentlemen had plenty of leisure to study the somewhat limited electrical field.

"There is a telephone system in the foreign concession in Shanghai," said Mr. Rae. "The European population in that section of the city numbers about 4,000. The Bell telephone is used and the English style of line construction is seen. They have excellent pole lines. The cross arms are of iron, and where cross arms are not used the insulators are placed upon iron brackets close to the poles. They string the wires very tightly, and this method of construction gives a line a very graceful appearance, but the lines are so close together in some places that I should imagine they would be troubled with induction. There is an exchange at Hong Kong which is distinctively English. They have no long distance telephone lines in any of the treaty ports.

"From Shanghai to Pekin, by way of Tientsin, they have a telegraph line of two wires, and there is another telegraph line, also of two wires, from Shanghai south to Canton, and a line up to Hankow. These lines were put in by the Great Northern Telegraph & Cable company, but while the telegraph company is a stock company it is controlled by the Chinese government and is called the Imperial Chinese Telegraphs. For construction a considerable amount of money was borrowed from the government, but it has since been paid back by service.

"On these lines the continental code and the old type of Siemens' polarized relay and ink recorder are used. In each telegraph office there is a code book containing a vocabulary of about 7,000 words—those most largely used—and each word has a number. When a Chinaman desires to send a message he hands it to the receiving clerk, who translates it into the code by numbers, and the operator sends the numbers. At the other end of the line the numbers are translated by the code back into Chinese, and the message in Chinese characters is delivered to the addressee.

"The officers of the company and the operators are Chinese. The company, of course, is semi-official in character, and the chief is appointed by the viceroy.

"It was arranged first that I should build a telephone line from the emperor's palace at Pekin to the viceroy's palace at Tientsin, a distance of fifty or sixty miles, but it was not found necessary for me to do that: the understanding is, however, that the line will be built.

"The chief value of the concessions lies in the banking privileges granted; secondarily, the privileges of railway, telegraph and telephone construction. The bank will be in position both to advance money for such construction, receiving, of course, a rate of interest, and will also be in a position to control a majority of the stock.

"What opportunities are there for telegraph and telephone operators in China?" was asked.

"None at all now," was Mr. Rae's decisive reply. "The Chinese have all the operators they need on both their telegraph and telephone lines. In addition, they have in their employ ten or a dozen Danes who act as electrical engineers, though probably they would get stuck if any one of them was sent out to set up a 'quad.'

"The manager of the Shanghai office, his assistant in charge of the operating department, the cashier, the chief clerk in the receiving department, and the chief in the delivery department, are all Chinamen, educated in America, and in the principal offices in Tientsin, Pekin and Canton there are English speaking Chinese thoroughly familiar with the operation of the telegraph, who are able, when necessary, to transmit a message in English, and to do so without difficulty. I have a message that Mr. Barberie sent me from one city to another. It was sent in English, received in English, checked, copied, and, of course, 'bulled.'"

At the conclusion of the laugh awakened by the last remark, Mr. Rae strongly reiterated his opinion as to the inadvisability of telegraph or telephone operators looking to China at present as a field of the most lucrative employment.

The advertisements which have appeared in various papers throughout the west and south offering high wages to operators to go to China, Mr. Rae asserted most positively had not emanated from the syndicate to whom the concessions had been made.

At present the company has not been organized, and, of course, officers have not been appointed, but there seems to be but little doubt that Wharton Barker, of Philadelphia, will be at the head of it.

The Electrical Engineering Department of Cornell.

The equipment at Cornell in the line of electrical engineering bids fair to become, if it is not already, the most complete in the country, and probably in the world. It has been almost wholly contributed by friends of the university, at the suggestion of the director of Sibley college and others interested in its progress. The last and most important addition to the collection is that of the Westinghouse 650-light alternating current dynamo, exciter, lamps and other material required in establishing the plant. The list of dynamos now includes the Edison, the Gramme, the Mather, the Westinghouse alternating current, the Westinghouse continuous, a number of Weston and minor makes, and all sizes, from a little toy machine made in the university shops, to the 50 or 60 horse power machines just added to the list.

There comes with this liberality on the part of friends of the university an embarrassment of real importance: there is no immediately available room for the installation of these machines. The dynamo room now appropriated to the purpose is hardly large enough for the "cradle" used in conducting experiments on a single machine. The Weston machine is tucked in one corner, and the Edison and Mather machines are temporarily placed in the middle of the floor, and driven as best can be done from there. There is actually no room even to lay down the new machines now *en route* from Pittsburgh, still less to place them for use. In this emergency, the director has obtained permission from the trustees to make temporary provision for them by throwing the existing toilet rooms into the machine shop, thus securing a space of some fifteen or eighteen feet by nearly forty, in which to place all these machines. It has long been considered advisable, on the score of safety and convenience, to remove all heavy machinery from the main building, and this transfer of the dynamo room will give opportunity to effect other improvements there in time. Professor Morris is already arranging new toilet-rooms, and getting ready to tear down the brick partitions which have been found to be in the way of the new arrangement. Professors Van Vleck and Smith are preparing plans for the belting and countershafting, in consultation with Professor Nichols, and the work is to be proceeded with at once. The space now given up to this machinery must, however, in time be required for the extension of the

machine shop, and it is only a question of time when a building must be constructed for this course and its collections. Nearly forty students now enter the course annually, and it is only second to the regular course in mechanical engineering in importance in the Sibley college organization. The expenditure of all that may be needed to make its material part complete, aided as it is so effectively by its friends outside the university, will be more than justified.

Professor Thurston estimates that about $100,000 should be expended in its permanent establishment: $60,000 on building, including $15,000 on water and steam power, each of which should give 150 horse power, the one for use in ordinary work, the other whenever experimental work compels the utmost possible regularity of speed; and the balance, $40,000, in supplying needed additions to the equipment of apparatus of exact measurement for heavy currents, and to furnish the income needed for running expenses, including fuel, one workman, and an assistant to the professor of physics, who should be placed in charge of this valuable property, which, although a part of the Sibley college establishment, is really managed by the department of physics in all except in its power-supply. It is not impossible, that, as Mr. Cornell used to say, "there is some one walking around who wants to provide this" now greatly needed laboratory. It is certainly an opportunity for some wealthy and public-spirited friend of the university and of this side of its work, to immortalize himself, while doing a noble work for his fellows.

A Voltaic Element With Movable Plates.

A. P. Laurie has invented a voltaic element with movable plates, constructed as follows, says *Electricité*; A glass receptacle is covered on the inside with platinum foil to which are soldered wires of the same metal. The platinum forms one of the electrodes of the element and presents a surface of 90 square centimeters. The receptacle is placed under a horizontal block of wood which has a deep circular groove on its upper surface. A border is seen upon the lower surface of the block, projecting from the groove. A small plate of cadmium is attached to this border, so as to have 10.6 square centimeters of its surface in the liquid. This plate communicates metallically with the border and consequently with a certain quantity of mercury placed in the groove of the block; it is this by which the current connection is made. The cadmium plate likewise traverses the liquid at the rate of two or three revolutions per second.

The motive force is furnished by a clock movement. The element contains about 100 cubic centimeters of a solution of iodide of cadmium, holding the iodine in dissolution.

The e. m. f. of this element, measured by the electrometer is 1.076 volts, and after allowing for its internal resistance, 1.084 volts. After having allowed the current to flow in the galvanometer for nearly two hours, there has been found, with the electrometer, an e. m. f. 1.072 volts and by calculation 1.067 volts.

The researches of M. Laurie sustain the belief that the e. m. f. indicated by the electrometer arises from the formation of iodide of cadmium.

The element has given during two hours an intensity of .01 ampère per square centimeter of surface in the cadmium plate, and the inventor makes the remark that this result is more than 500 times that which can be obtained from an element with fixed plates without causing any serious diminution of e. m. f. He concludes by saying that this diminution in an element with fixed elements arises from the modifications of the force of the solutions close to the plates, and he claims that his apparatus has a right to the title of a constant voltaic element.

Personal Paragraphs.

C. F. Annett, general manager of the Rocky Mountain Bell Telephone company, was in Chicago the early part of the week on his return from the east to his home at Salt Lake City.

Theodore P. Bailey, formerly special agent for the Thomson-Houston company at Kansas City, now makes his headquarters at the general western office of the company in the Pullman building, Chicago, where he has assumed a more important position.

Estimating the Cost of the City Plant.

As noted last week Professor Barrett, city electrician of Chicago, was directed by an ordinance to prepare an estimate of the cost of lighting a large section of the business portion of Chicago —from Chicago avenue on the north to Twelfth street on the south and the lake on the east to Halsted street on the west—by the electric light, the city to own and operate the plant. The professor has not yet secured the data necessary for the estimate, but figures that were made some time ago upon the cost of establishing an electric light plant for a limited district bounded by the river, Twelfth street and the lake establish a basis for comparing the cost of lighting the business part of the city by electricity and by gas.

Within the last described territory, that is, that section bounded by the river, Twelfth street and the lake there are 1,300 gas lamps which cost $17.12 each per year or a total of $22,256 per year for maintenance. Within the same district there are 150 street intersections, for which the professor makes the liberal allowance of two arc lights each or a total of 300 arc lights. A proposition has been made by a company to light that section at $70 per arc lamp per year, or a total of $21,000, which as compared with gas shows a saving of $1,256 per year. But the professor thinks he can do much better than this if the city owns the plant.

The river lighting plant, concededly an expensive one on account of its peculiar method of construction and including engine, boilers and fixtures—everything ready to run—will cost about $30,000 and as it will light 100 lamps the cost per lamp will be about $300. At this cost per lamp which from the circumstances, is extraordinary, the cost of a plant for the territory described would be $90,000, but even at this cost the professor declares he can make a saving.

On the north side of the river $17.12 is also paid for each gas light per year while on the west side $26.62 is the price per lamp per year. Therefore if a saving can be shown at $17.12 for each gas lamp a larger proportionate saving can be made at $26.62 per gas lamp.

These figures of course, are made without reference to the increased quantity or quality of light furnished by the arc light. Here, of course, the gas light does not stand in comparison with the electric light.

He Thought a Hole Through a Board.

"I can make you think a hole through a half-inch board," was the rather startling remark made to a New York reporter.

The speaker was Edward Weston of Newark, one of the leading experts in electricity of the world.

Mr. Weston has fitted up in the rear of his place in Newark a laboratory for the purpose of scientific experiment and research. It is a veritable Aladdin's palace, having been created by the "slaves of the [electric] lamp," and having as many magical appurtenances as ever the genii could boast of.

Entering the physical department, Mr. Weston produced two thermopiles. A thermopile is a device for generating electricity direct from heat. It consists of bars of dissimilar metals placed close together, alternately, so that a section cut through the thermopile would resemble a chess board, one metal representing the black and the other the white squares. These bars are insulated from each other, except at alternate ends, where electric connection is made. The application of heat at once excites an electric current in the thermopile, as was shown to the reporter by several experiments.

"Now," said Mr. Weston, "I will connect two of these thermopiles by this wire. They are connected in opposition, so that as long as the same amount of heat is applied to each they will neutralize each other, and there will be no electric current to run this electric motor, which is in the circuit. But if one is heated more than the other the greater current will overpower the lesser, to use a commonly understood way of expressing the result, and a current will pass to the motor.

"I place one thermopile in this dish, surrounded by water, which I keep exactly at the normal temperature of the blood—98.5 degrees. Of course that would excite a current, but I neutralize that current by placing the other thermopile in contact with your temple. You see, the two thermopiles now counteract each other, since the same degree of heat is applied to each. Now, take a problem in mechanics and solve it. Are you ready?"

With a thermopile pressed against the starboard lobe of his alleged brain, and enough wires and other electrical appliances close at hand to send him to Lucifer if he refused, the reporter intimated his willingness to attack a problem, if it were only a little one.

"All right. Now suppose you drop a stone down a coal shaft and hear it strike bottom in five seconds, how deep is the shaft? Remember, $s=vt$ and $v=\frac{1}{2}gt$, and you can allow 1,142 feet per second for the velocity of sound."

It is hardly necessary to say that the reporter struggled with that problem with an energy born of despair. He quickly forgot all about the electric experiment and was bent upon reconciling the conflicting demands of the time of the stone's downward flight and the time of the upward flight of the sound made by its striking, the two intervals equaling five seconds.

Suddenly he was aware of a buzzing in the motor. It began to spin faster and faster until he lost interest in the problem, when it began to slacken speed.

"Ah!" said Mr. Weston, "stick to your mechanics or you deprive the motor of power. You must keep up your mental exertion if you want to bore that hole."

Thus adjured, the reporter struggled with the mechanical and algebraic difficulties of the case until, having got utterly muddled with v and g and t, he couldn't have told whether the shaft was 50 or 500 feet deep. He made a valiant struggle, neverthless.

As his supposed brain wrestled with the problem the temperature of his head increased and the thermopile in contact was, of course, heated above its twin, which remained at the normal blood heat. As this difference in temperature generated an electric current, which current ran the motor, it was evident that the latter was being driven practically by the reporter's efforts to solve the problem. And as the motor, with a loaded fly wheel, carried a fine drill on its axis, the piercing of a piece of wood by the drill was easily accomplished, long before there was the least prospect of the depth of the coal shaft being discovered.

Thus Mr. Weston had literally kept his promise of making the reporter "think a hole through a half-inch board."

CORRESPONDENCE.

Eastern Electrical Comment.

New York, Oct. 29.—The announcement that the Western Union and its only competitor, the Postal and United Lines, had made an amicable agreement regarding rates can hardly be called a surprise, as it has long been apparent that neither company approved of the Baltimore & Ohio schedule. The influx of business is giving the Postal management all they care to handle and do it well. Some difficulty is being experienced is obtaining overhead permits in order to bring the newly acquired wires into the Western Union building.

The Board of Electrical Control, at its last meeting, appointed President Hess a committee of one to hear arguments upon the question of iron *vs.* wood as a material for lamp posts for the new arc lighting circuits which are soon to be established. Commissioner Gibbens had determined that all posts to be erected hereafter should be of iron. His advocacy of iron was sufficient to develop Mayor Hewitt's objection to that material which he had learned would increase the danger to human life. Professor J. J. Wood, of the American Electric Manufacturing company, was the leading witness in favor of wooden poles, and he gave his reasons for his opinion with great accuracy and clearness. All of the testimony went to show that with iron posts no lineman or trimmer should attempt to climb while the current was on, neither was it safe to go up a wooden pole on a wet night. From the various statements it appeared that the only reason for adopting an iron pole were its neater appearance and durability. In the course

of the discussion the general unsafe condition of the arc wires in the city was brought up. An allusion was also made to the death of a lamp inspector at the Harlem station. No official information regarding the affair was elicited, but according to the newspaper report he was in the cellar watching a couple of men working at a dynamo. His head hit against an arc lamp hanging to the ceiling and set it swinging. He reached up suddenly and took hold of it, and died in a few moments from the shock.

The mayor has been critically examining the estimates for the different city departments. His opinion appeared to be that the clerks were generally paid too much for too little work. A hundred thousand dollars was asked for by the fire department for placing the fire alarm wires under ground. This amount will probably be granted.

The iron pipe manufacturers held a meeting at the Fifth Avenue hotel, Wednesday, and arrived at the conclusion that wrought iron pipe was selling at too low a price, considering the increased demand for its use in the petroleum and natural gas fields, and also for electric wire conduits. It was finally decided to advance the price two and a half per cent. on all sizes.

The electric light and electric railway wars which were being waged furiously in Elizabeth, N. J., a few weeks ago, have entirely subsided. The Schuyler and Westinghouse companies have consolidated, and the system of the latter is to be built under the franchise of the old company. The horse railroad interest has been too vigilant to permit the electric motors to gain a foothold, and the Jersey freeholders will be permitted to continue their travels in the old way.

The recent call by the National Electric Light association for funds with which to print its transactions, seems to indicate that too much work has been cut out to be borne by a comparatively small revenue. The National Telephone Exchange association experienced a similar difficulty, and met it by raising the dues to $50 per year. P.

New York Notes.

New York, Oct. 29.—The exhibition at the American institute is attracting a large number of visitors, and is the most successful one held in several years. The electric railway is doing a flourishing business, giving its passengers a 300-feet ride and return for five cents. There is a large number of Sprague motors exhibited, all in operation. A large printing press, an elevator, a blower and other machinery are driven by these motors. The C. & C. Motor company also show their motors in operation, driving sewing machines and doing other light work. Professor Elihu Thomson's method of electric welding attracts much attention, as does also the historical collection.

The Steinway & Hunter's Point Railroad company of Long Island city, has decided to adopt a system of electricity for transportation instead of horses. The change will be made next spring.

Lulu Hurst, in her palmiest days, never exhibited such wonderful magnetic power as was exercised by a man in this city one day this week. John Walker was brought to the Jefferson market police court on the charge of rolling away a barrel of flour from a grocery store. He gave as his defense that as he was passing the store the barrel rolled into line behind him and followed him. A man with such magnetic attraction is hardly a safe one to be at large.

A few days ago a test was made at Newport of the efficacy of electric lights for defending war ships from torpedo boats. The ship Dolphin is equipped with one electric search lamp, and the Atlantic with two. Although the attack by the torpedo boats was made with all possible skill and quietness, yet their approach was readily detected on the gun boats. The trial demonstrated to the naval officers that the electric search lamp was one of the best defenses against the attack of the torpedo boats yet tried.

George Schneizer, an inspector of lamps for the Harlem Electric Light company, was killed in a singular way this week by coming in contact with a defectively insulated lamp. The lamp hung in front of one of the dynamos in the station, and Schneizer's hat set it swinging as he passed and touched it. He caught hold of the brass tube that holds the lower carbon to stop its swinging. With a spasmodic shiver he dropped to the ground and died in five minutes.

The *Sun* of last Sunday gave a column and a half description of the Metropolitan's new multiple board. Telephone men will be interested in hearing a reporter's definition of some parts of the board. For example, "a jack is a magnetic arrangement easily held in the hand, and when a peg is stuck into one it connects two wires. Just below the board is a shelf containing the answering jacks, pegs and little straps which tumble down when a subscriber rings up and which shows his number."

The officials of the Postal Telegraph company have formally announced that as a result of a conference the rates of the Postal company will be advanced to the Western Union standard on all messages under twenty-five cents, and that where the standard is higher than that figure the competing companies will make a slightly lower lower rate.

The telegraphers connected with the Baltimore & Ohio company have organized the Phœnix Electrical and Social club. C. W. Price, formerly superintendent, has been presented by his associates a locket appropriately inscribed and adorned with diamonds. S.

Omaha Gossip.

Omaha, Neb., Oct. 29.—The Lincoln District Telegraph company are now thoroughly established for business, with 400 boxes of the McCulloh patent in use. Their lines are strung in the best shape, particular attention having been given to joints and connections. Number 12 brown insulated wire was used, and in nine miles of wire strung less than a dozen splices are made in the air and these are securely soldered.

The Lincoln Electric Light company are pushing the construction of their incandescent plant and have already placed 400 lamps. The Westinghouse alternating system will be used. The Western Engineering company, of Lincoln, are the construction contractors.

The B. & M. railroad company here had a busy season extending their telegraph lines in all directions to keep pace with the track extension and have opened up many new offices; Holdrege to Cheyenne, Central City to North Platte, Orleans to Wano and Wahoo to Schuyler are among the connections recently completed and equipped.

The Nebraska Telephone company will put in an exchange at York, Neb., with 100 subscribers. Trunk line connection will be made with Seward, bringing the new exchange into their extensive system. Hard drawn copper wire will be used and the route will be completed in six weeks.

The Thomson-Houston company, of this city, started their incandescent plant week before last with flattering prospects of success.

All the linemen to be found in search of a winter's job have been sent from here to California and other points west, where telegraph building seems to be on a decided boom.

Frank B. Knight, of the American Bell Telephone company, and a former resident of this city, was a welcome visitor last week. W. W. Low, of the Detroit Electrical works, and genial Jean A. Wetmore, of the Okonite company were also noticed.

Israel Lovett, superintendent of the Midland Electric company, left last week for an extended business trip and a visit to his former home in Beverly, Mass. W.

Indianapolis Items.

Indianapolis, Ind., Oct. 29.—The Central Union Telephone company at Lafayette, Ind., have encountered a number of suits, the decision of which will be awaited with interest. Patrons have determined to pay only the legal rate of $3 a month; one sues for a mandate to compel the company to put a telephone into his bank; another sues for damages for refusal to put in a telephone at the lawful rate; others have suits of one kind and another to compel a compliance with the law.

The Valparaiso, Ind., city council, who a short time since ordered the Central Union Telephone company to remove their poles and wires immediately, have modified the ordinance and extended the time for removal to May 1st, 1888.

The Jenney Electric company of this city have closed a contract for furnishing an electric lighting plant to the Home for feeble-minded children, a state institution about completed. The contract calls for 300 incandescent lamps at present.

The work of wiring the new Union railway station here for the electric light is being pushed forward.

The Indianapolis Writing Telegraph company have been granted rights to certain streets and alleys, for poles and wires, for which privilege they grant the city free use of 25 instruments. The operation of the instruments, which are something like type writers, is similar to the gold and stock ticker. A message can be sent to a subscriber's office whether he is in or not. M.

Detroit's Budget.

Detroit, Oct. 29.—The latest duty imposed upon the public lighting committee is to investigate the complaint of one Geo. A. Chase, that a "combine" exists between the Brush and Thomson-Houston electric light companies. The existence of the "combine," it is stated, is the reason why the Brush company's bid is the only one received for the city lighting. Ex-Alderman Chase states that the Brush company never was entitled to erect poles or towers in Detroit, not having been empowered to do so by the legislature. In support of this argument he referred to the veto of Mayor Thompson in 1881, when the right to erect poles and towers was denied to the company. The other charge made by Mr. Chase, and which he thought went to show a "combine," was that the Thomson Houston company took its wires out of the Dorsett conduits and put them on the Brush company's poles, under pressure brought by the latter company, which was afraid that if the smaller company continued to successfully operate underground circuits it would be only a short time when it too would be compelled to follow suit. The chairman of the committee thought the proper way to reach the matter was to have the council ask the city's legal officers on what authority the Thomson-Houston company was carrying its wires overhead, and also on what authority the Brush company was renting its poles to a rival company.

At the next meeting of the underground committee a resolution will be introduced, it is said, recommending the city attorney to take action against the telegraph and telephone companies for violating the ordinance relating to overhead wires.

Mayor Hartsuff, of Port Huron, has appointed a committee to investigate the cost and practicability of the city establishing its own electric light plant. The Thomson-Houston company now furnish the light, but the council figure a big reduction if the city purchase and operate its own plant. Plenty of power can be supplied from the new water works engine.

There is considerable electric light construction now going on at various points in the state. The Battle Creek, Ludington and Greenville plants are in operation, and Albion and Ithaca expect to have additional lights within a few days.

The Highland Park electric railway company has completed the leveling and raising of its conducting rail in the center of the track. Experiments made on the part finished proved entirely satisfactory and the desired object attained—more speed and greater ability to start promptly when the current is turned on.

The West Bay City Electric Railway company has been organized. Capital, $30,000. Congressman Fisher is the president.

The Calumet & Hecla's output for the week ending Oct. 17th was 689 tons, 1,445 lbs. This is the largest output of any copper stamping mill in the world. C.

THE ELECTRIC LIGHT.

Albion, Mich., has contracted for twenty-five arc lights for street-lighting purposes.

The great dragon drawn in a recent Chinese procession in San Francisco by six Chinamen is described as follows: From a point just under the

mansard roof of the dragon's head to within three feet of its tail there is a network of electric wires, all communicating with a complicated machine located in close proximity to his lower jaw and out of sight. One of the men who march under it, at a given signal, touches an ebony button, and the electricity causes the huge jaws to fly open, disclosing a mouth like a tunnel, filled with frightful fangs, and darting tongues of fire.

The Greenleaf Electric Light & Telephone company of Greenleaf, Kan., have elected the following officers: E. E. Calvin, president; A. M. Foreman, first vice-president; O. C. Axtell, second vice-president; J. W. Bliss, secretary, and E. Nims, treasurer.

The city council of Cherryvale, Kan., has granted Capt. C. T. Ewing a franchise for five years for operating an electric light plant, and has contracted for five lights, at the rate of $100 per year each. The plant is to be in operation within sixty days.

The business portion of Salina, Kan., is to be illuminated by electric light, pursuant to a recent vote of the city council.

THE ELECTRIC MOTOR.

The Silvey Electric company, at Lima, O., organized on the 26th ult., by the election of the following officers: President, B. C. Faurot; vice-president, George D. Ryder; secretary, F. P. Graf; treasurer, F. L. Langan; electrician, and general manager, W. L. Silvey. The board of directors consists of the above officers, and George Feltz and D. J. Cable. The stockholders include, besides the foregoing, Wm. Graver, of Englewood, Ill.; L. E. Osborn, of Bradford, Pa.; Howard Strong, of Olean, N. Y.; B. C. Colwell, of Portville, N. Y.; E. G. Atkinson, of Waynesfield, O., and George Fetter, of Lima, O. The capital stock is $50,000, and motors, dynamos and the Silvey electric headlight will be manufactured.

THE TELEPHONE.

Steps have been taken in Rochester, N. Y., tending towards a settlement of the dead lock between the subscribers and the Bell Telephone company. It is announced that the telephone company will put their instruments into use at a flat instead of a toll rate.

The Cushman Telephone & Service company of Chicago have applied to the city council for permission to establish a system of electrical conductors, under ground, and on poles and housetops for a telephone exchange.

A dispatch from St. Louis, dated Oct. 22nd, says: Philip L. Rose, the Pan-Electric telephone manufacturer, temporarily enjoined last week from manufacturing infringements of the Bell telephone, applied to the United States circuit court to-day for permission to reopen his shop under bond, but was refused, and the injunction continued until the final hearing of the case. The Bell company to-day entered two suits in equity for infringement of patents—one against the St. Louis Battery company and the other against A. S. Aloe & Co. These suits are brought in pursuance of the plan of the company to bring suit against all, one after another, of the alleged infringers.

The first grand ball given by the telephone and electric light linemen of Topeka, Kan., was held October 20th, at Music hall, and was very successful in point of numbers and the enjoyment of those in attendance. The hall was brilliantly lighted by incandescent lights, and a chime of electric bells and numerous telephone instruments properly connected, made the boys feel very much at home. Before announcing each dance one of the floor managers called attention by pressing a button which rang a chime of bells. The following gentlemen acted as floor committee: Charles Masten, William Frizell, John Pucket and L. C. Redmond.

THE TELEGRAPH.

A rumor comes from Wall street, New York, that President Chandler of the Postal Telegraph company and Jay Gould of the Western Union have held a conference and that the outcome was a determination to advance rates.

E. D. Barrett, telegraph operator at the Sycamore station on the Minnesota & Northwestern railway, committed suicide by drinking a bottle of laudanum on the 26th ult. Depression, due to dissipation, is alleged to have been the cause.

NEW ENTERPRISES.

Ennis, Pierce & Co., of Rushville, Ind., will build a new engine house of one story to cost between $3,000 and $4,000.

The Stewartsville Coal company, of Stewartsville, Mo., have called for bids for sinking a coal shaft. B. F. Clark, of the same place, is secretary of the company.

The Baptist society, of Jefferson City, Mo., will build a new church to cost $10,000.

Col. R. M. Hurst, of Kansas City, Mo., will erect a building to be used as a hotel, flats and apartments. It will cost $300,000. Electric bells and electric lighting apparatus will be put in.

Judge William Sloter, of Centralia, Ill., is about to put up a two-story residence.

The Georgia Marble company, of Tate, Ga., will put in a large electric light plant.

J. H. Campbell & Co., of Higginsville, Mo., have called for bids on a steam plant and machinery for coal mining. They will use compressed air.

White & Todd, of Aurora, Ill., will put up a business block of two stories to cost $20,000. J. E. Minott, of Aurora, is the architect.

Miscellaneous Notes.

A Washington dispatch announces that John Russell Young, ex-minister to China, is at the head of a company formed for manufacturing and selling McLaughlin's electrical type writer, or dynamograph, as it is termed. Philadelphia and Washington capitalists are interested financially. The instrument is a type writer on which a message can be written as on the instrument of that name widely known and used, but the message is transmitted electrically to a desired distance and reproduced precisely as written.

The first young girl to be cremated in America was 9 year-old Alida Weissleder, the daughter of the superintendent of the Brush Electric Light company in Cincinnati. Her body was burned last week at a crematory in that city. The corpse, wrapped in white alum linen, with white and yellow roses on the breast, was slid into the retort by two attendants, who at once retired, and in the stillness that followed the mourners could hear the puff and sizzle of the gases of the body as the heat devoured it. After an hour the blue flames stopped circling about the body, and a long white streak was seen where it had been. These ashes when gathered up weighed less than a pound. They were returned to the parents, and will be preserved in an urn. It was the ninth incineration at the crematory.

L. McCormick, electrician of the Newton Electric Light company, has devised and patented a new grate designed to burn slack coal.

Following are the assessments upon some of the corporations of Cook county, Ill.: Baltimore & Ohio Telegraph company of Illinois $17,368; Central Union Telegraph company $58,817; Chicago Telephone company $172,438; The Chicago Sectional Electric Underground company $135,000; The Sun Electric Light company $8,630; The Western Edison Electric Light company $25,000.

A syndicate of Belgians has obtained from the Persian government the concession for constructing a railway in that country. The first line will run from the capital, Teheran, to the celebrated place of pilgrimage, Shah-Abdul-Azim, a town of 90,000 inhabitants, and it will be about ten kilometres in length. The concession granted to this Belgian company has, however, an importance for them far exceeding any value that can be attached to any single line of rail, for it entitles them to the exclusive right of constructing and working a long line from the Caspian sea to the Persian gulf. The significance of this railroad, commercially and politically, needs no comment. The name of the company will be, "Societe Anonyme Belge des Chemins de fer Persans," and is now established in Brussels.

A Sicilian has invented a method by which cremation is accomplished by means of electricity. It requires a dynamo like those employed for arc lights. It is stated that the effect of the intense heat is to vaporize the entire body.

According to the Earl of Rosebery the telegraph, the telephone and the postal card, in addition to shorthand, are nothing but the signals of distress of an overstrained civilization.

Henry Clay of Philadelphia has devised an electro-pneumatic system by means of which a carrier can be dispatched from a main station through an underground tube and switched off by the operator at any way station at will, without interfering with other carriers which may be travelling in the tube at the same time.

It is expected that before long a practical test of one of the numerous harnesses for the control of Niagara's power, brought into existence under the stimulus of a $100,000 prize, will receive a practical test which will demonstrate its use or prove it a failure, and give something further on which to base arguments that Niagara contains no great shakes of available power, runs a Buffalo press dispatch. An endless chain, with feathering buckets, was the invention of a Buffalo man. The rights for Erie and Niagara counties he sold for $65,000. He says that he has a contract for that amount. A stock company with $1,000,000 capital is to be formed if the coming test proves successful. George W. Smith has obtained backing to the amount of $10,000, which is the amount a 1,000-horse power machine will cost, and he has received the necessary permission from the secretary of war to place the machinery in the river. Mechanical drawings are now being made, and it is expected that the machine will be tested this fall.

A speaker at one of the recent anarchists' meetings in London is credited with the following: "My blood boils when I think of the sufferings to which the workingmen of Chicago have been subjected, in the hope that in their agony they would 'peach' on their comrades. They were imprisoned in what they called 'sweat boxes'—dark cells five feet high and four broad. To the walls and bed are attached galvanic batteries, turned on at the will of the turnkey. The hapless prisoner can neither sleep nor rest. Through apertures powerful colored lights are turned on suddenly, and the prisoner goes wild with fear. Late at night scoundrelly hirelings are let into the cell to belabor the prisoner with clubs until dawn. This treatment is begun again the following night, and is continued till the prisoner expresses his willingness to testify to anything the district attorney may deem necessary for his conviction." This, forsooth, is a well depicted picture, but so long as it is a picture only, it may be subjected to some criticisms in regard to coloring. Before the next speaker attempts to work in the galvanic battery as an instrument of torture of the Chicago inquisition, he should take counsel with some expert electrician, who might be able to tell a tale still more startling, or, for the occasion, invent some instrument much more cruel than the galvanic battery.

On the Wabash road a rule has been promulgated that all conductors, engineers, and yard masters, train dispatchers, section or bridge foremen, and every officer connected with the operating department shall carry watches of a certain standard of excellence certified to by an examiner. The requirements are that each watch must be fifteen jeweled, with patent regulator, adjusted to heat and cold and protected from the effects of magnetism, although it is said, on the authority of the examiner, that while the anti-magnetic shield is advised for use it is not made compulsory.

Very elastic caoutchouc tubing gradually loses some of its elasticity. Later, the tubes break on stretching, even if previously laid in warm water, and finally they crack if pressed between the fingers. This change is put down to a very slow formation of sulphuric acid by the action of moist air on the sulphur contained in the caoutchouc. By frequent washing with slightly alkaline water the action of the acid is prevented. Tubes

washed five or six times a year remain perfectly elastic, it is said.

The McIntosh Galvanic & Faradic Battery company of Chicago are making a new milliampère meter, similar to that shown in No. 1 of the WESTERN ELECTRICIAN, but on which the reading will be only to 20 milliampères, the design being to so widely separate the divisions on the dial that the slightest movement of the indicator will be very readily perceptible. As may be inferred, the instrument will be used for exceedingly delicate work, such as brain work in electro-medical practice.

It is asserted that 28 miles of cable railway will be in operation in Kansas City by the close of the present year, and that 21 miles will be constructed in 1888.

A Hartford man has invented an apparatus for timing horses. A clock with three hands—minute, second and quarter second—is started by the official timer. When the winning horse touches the wire the clock is stopped by electricity. At the same instant the current opens a camera, which photographs the horse and the clock face.

A New York correspondent discussing the question whether the metropolis is a sleepless city, argues that it is no more so than the village of Nantucket in the winter, or than any other village in which there are one or two constables, a nightly party of dancers, a clerk kept up over his books, a watcher at the bed side, and one or two others sitting out the night. "Ten thousand out of the population of New York is only one in every 160 residents. If you include the strangers in town every night, as you must do, it is one in 180. That is equal to ten men up all night in a village of 1,800 inhabitants; so that New York is above the average after all, but not enough to be called sleepless. The 10,000 is made up in this way. There are about two thousand city and park policemen on duty most of the night, about one thousand bakers at work till morning, about three hundred and seventy-five in the headquarters of the gas, electric light, steam heating and telegraph companies, about two thousand private watchmen in buildings and in the streets, about three hundred night hands at fifteen ferries, about three hundred and sixty men at work on the two all-night elevated roads and the three lines of horse cars that are run incessantly, and, finally, it takes about seven hundred and fifty men to perform night service in the hotels, one hundred men to drive the night cabs, and about two hundred and fifty men as clerks in the all-night restaurants and drug stores, and about five hundred in miscellaneous places, like the bridges and hospitals, for instance. The all night list, as I have set it forth, foots up about 7,500 souls. Add to these 1,500 dancers during eight months of the year, and under two thousand stragglers of all kinds, and the total is less than eleven thousand. The figures are, if anything is amiss with them, too high by 1,000.

Business Mention.

The Electrical Supply company, 171 Randolph street, Chicago, are introducing in the west paint made by the Standard Paint company for insulating electric wires. They have had the paint under trial for some time and are thoroughly convinced of its merits. It retains its flexibility and cohesive power, does not scale like asphalt, does not oxidize and is not affected by sudden changes in temperature or by moisture. A length of underwriter's wire covered with a single coat of paint and kept in water for several months showed no depreciation in the insulation.

The Western Electric company of Chicago are filling orders for ten miles of 100-conductor standard metallic cable for Buffalo, N. Y.; 3,800 feet of 150-conductor cable for the Ohio Valley Telephone company, Louisville, Ky., all for underground work, and 31,000 feet of electric light cable for the Chicago Arc Light & Power company of Chicago.

The Detroit Lubricator company, in a circular of late date, defines its position in regard to the recent decision by Judge Colt, at Boston, in the Seibert and Lunkenheimer case. The Detroit company was in no way a party to that suit, although its sympathies and interests were on the side of the Seibert company inasmuch as an amicable settlement of all matters of difference between them was made December, 1883, and still prevails.

The Western Electric company's plant at St. Louis has been increased by another 30-light machine, making the total capacity 150 lights.

Independence, Mo., is to be lighted by a 60-light plant of the Western Electric company's make.

The same company has recently taken a contract for a 30-light plant at Keyport, N. J., and another 60-light plant in addition to one of the same size already running in Scranton, Pa.

A recently incorporated company is the Electric Construction company, of Lawrence, Kan.; capital stock, $25,000; directors, C. W. Cook, E. Rousel, J. E. Jeffries, F. A. Mead, E. P. Tremper.

The United States Fire Alarm company of Evart, Mich., has recently furnished the city of Hastings, Mich., an alarm, using one of their mocking bird whistles. For a public or general alarm it is very satisfactory.

The Vitrite & Luminoid company of New York have suspended payment. It is expected that their embarrassment will be only temporary.

The Central Electric company, 38 La Salle street, Chicago, have secured the western agency for the Okonite company.

Many gas companies of the United States are considering very carefully the question of combining electric lighting with their gas plants. No small number of companies have accepted the situation, and become earnest advocates of a combination. The following gas companies have adopted the American system of electric lighting: Brookline Gas Co., Brookline, Mass., 150 lights; Citizens' Gas Co., Jacksonville, Fla., 100 lights; St. Paul Gas Light Co., St. Paul, Minn., 500 lights; Citizens' Gas Co., Jackson, Tenn., 50 lights; New Albany Gas Co.. New Albany, Ind., 50 lights; Citizens' Gas Co., Orange, N. J., 50 lights; Columbus Gas Co., Columbus, Ind., 50 lights; Glens Falls Gas Co., Glens Falls, N. Y., 100 lights; Halifax Gas Co., Halifax, N. S., 100 lights; Meriden Gas Co., Meriden, Ct., 150 lights; Oswego Gas Co., Oswego, N. Y., 35 lights; Paris Gas Co., Paris, Texas, 35 lights; Portsmouth Gas Co., Portsmouth, Va., 100 lights; Saratoga Gas & Electrical Light Co., Saratoga, N. Y.. 175 lights; Schenectady Gas Co., Schenectady, N. Y., 35 lights; Seattle Gas Co., Seattle, Washington Territory, 100 lights; Tacoma Gas Co., Tacoma Washington Territory, 50 lights. The majority of these companies find the electric light working so satisfactorily and so much more profitable in connection with gas than at first anticipated, that they are now contemplating increasing their arc light apparatus.

The Concordia Electric Light company, of Concordia, Kan., has ordered another 30 light dynamo of the Western Electric company, of Chicago, increasing the capacity of its plant to 90 lights.

Seattle, W. T., which has been using the American system for the past six months, has decided to increase its plant, and has just ordered another 50 light plant from the American company.

The National Electric Construction company, of Chicago; capital stock, $100,000; incorporators, J. E. Tuttle, Frank A. Wunder and Olive G. Fessenden is a recently incorporated company.

A Cleveland dispatch of the 14th inst. states the Cleveland Electrical Manufacturing company began suit in the United States circuit court against the Cleveland Electric Matting company. It is claimed that the plaintiffs own valuable patents on an electro-magnetic watchman's register which are being infringed upon by the defendants. The court is asked to enjoin the defendants from further infringing on the rights of the plaintiffs, and also to render such relief as the case deserves.

The United States express building at Chicago is being wired by Leonard & Izard for Edison lights.

The First national bank building at Omaha, Neb. is being wired by Leonard & Izard of Chicago for Edison lights. The same company are acting as consulting engineers in the remodeling of the central station plant at Appleton, Wis.

Electrical Patents.

Issued October 18 and 25, 1887.

371,869. Coin Operated Electrical Weighing Scale. Edwin R. Whitney, Manchester, N. H.

371,876. Fire Alarm Telegraph. Charles Burgher, Boston, Mass.

371,893. Electrical Distribution and Charge of Secondary Batteries. Frank King, Fulham, County of Middlesex, England.

The first claim is as follows: "The combination of two or more secondary batteries or sets of secondary batteries, a charging-circuit, a distributing circuit, switches — one for each battery or set of batteries — for transferring the same from one circuit to the other, magnets for operating said switches, and means as indicated, for opening and closing the circuits of said magnets at the proper times, substantially as described."

371,915. Governor for Incandescent Lights on Arc Circuits. Chauncey D. Baker, Chicago, Ill.

A single compound solenoid is used in connection with a resistance box and commutator.

371,936. Electric Railway. John Hartman, jr., Philadelphia, Pa.

371,937. Rheostat. John Hartman, jr., Philadelphia, Pa.

371,940. Electrical Communicating System. Alfred G. Holcombe, New York, N.Y.

A telephone exchange system designed more especially for hotels and factories. Individual lines not in operation are utilized as a return circuit from a room when communicating with the office.

371,958. Electric Current Indicator. Wyllis H. Markland, Altoona, Pa.

An electro-magnet of circular shape acts upon an S-shaped armature, pivoted to revolve in the plane of the magnet.

371,965. Hauling-through Conduit System. James F. Munsie, Chicago, Ill.

The cables are carried into the conduit upon a chain roller bed.

371,980. Automatic and Autographic Telegraphy. Chas. Selden, Baltimore, Md.

This is a duplex or quadruplex system. Currents of varying strength and polarity are employed, each pen being controlled by a separate finger

372,012. Electrical Resistance-Board. Irving W. Colburn, Fitchburg, Mass.

372,026 (1). Electrical Safe Lock. 372,027 (2). Electro-magnetic Safe Lock.

372,028 (3). Electrical Safe-lock. 372,029 (4). Electrical Combination-lock. Charles J. Kintner, Philadelphia, Pa.

(1) The combinations of the lock are made electrically, the circuits running from the outside to electro magnets within the safe. A safety circuit is provided to avoid detection of the combination.

(2) All the bolts and bolt controlling apparatus, are located inside the vault and electrically controlled from the outside.

(3) A series of insulated electrical contact plates are used instead of the gate, one such plate being provided for each number on the dial plate. By bringing all the plates into a particular relation with respect to their contact springs, a circuit is completed through an electro-magnetic device to release a locking bolt.

(4) The lock and electrical apparatus are located inside the safe and operated by conductors extending through the door. The circuit connections are arranged so that one must follow the exact sequence of the combination.

372,046. Electrical Primer. George Stuart, Elswick Works, Newcastle-upon-Tyne, England.

The primer is designed primarily for use with axial vented guns.

372,078. Underground Electric Conductor. Harry Metzger, Pittsburgh, Pa.

The object of the invention is stated to be: To remedy altogether the adverse effects of leakage and to mitigate the effects of electro-magnetic induction between wire and wire, and to counteract and in a great measure to eliminate the retarding effects of the electro-static induction between the wires and the earth in underground cable systems.

372,155. Telegraph Key and Sounder. George M. Lane, Asbury Park, N. J.

372,167. Fire Extinguishing Apparatus. William Meracher, Cleveland, Ohio.

372,168. Coin-operated Induction Coil. William Oliver, London, England.

372,193. Galvanic Battery. James T. Armstrong, London England.

The electrolyte or exciting fluid consists of saponified oils or fats. The electrodes are kept clean by changing the charge or exciting fluid from one kind to another, which will neutralize the objectionable effects of the antedent fluid.

372,201. Regulator for Dynamo-Electric Machines. Charles E. L. Brown, Zurich, Switzerland.

372,208. Electric Valve Controller. Simpson W. Dermitt and Wesley V. Dermitt, Pittsburg, Pa.

372,231. Regulator for Electric Motors. Alexander W. Meston, St. Louis, Mo.

372,245. Autographic Telegraphy. John E. Watson, Louisville, Ky.

372,247. Call Register for Telephones. Arthur F Adams, Little Rock, Ark.

372,273. Railway Rail and Conduit for Electric Wires etc. James T. McNulty, Philadelphia, Pa.

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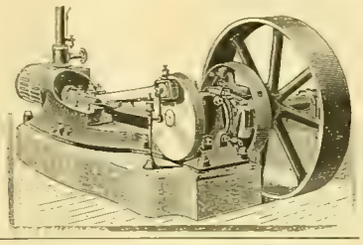

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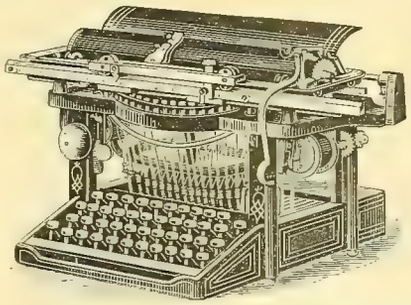

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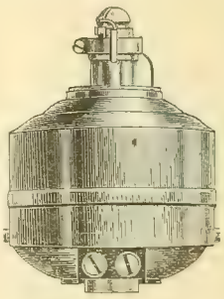

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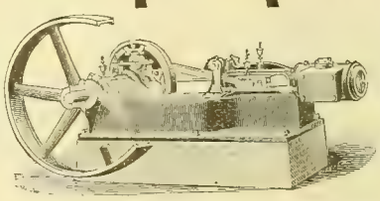

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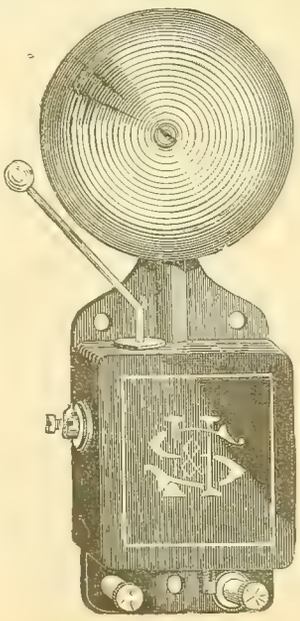

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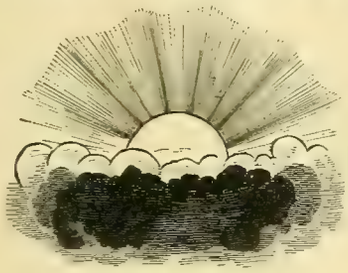

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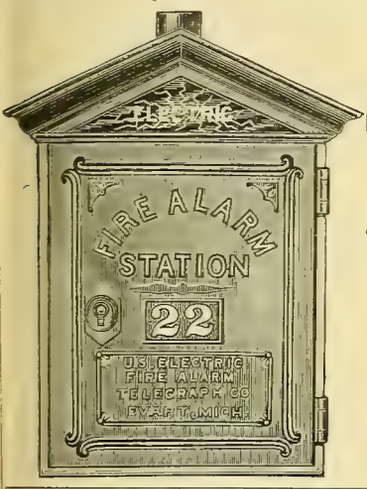

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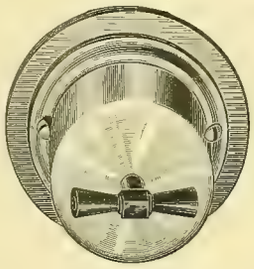

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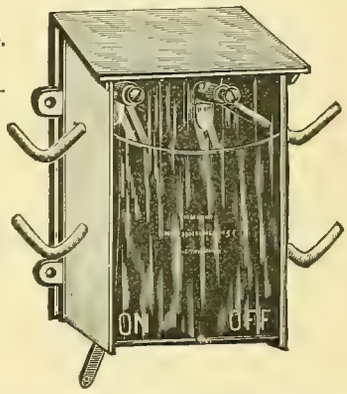

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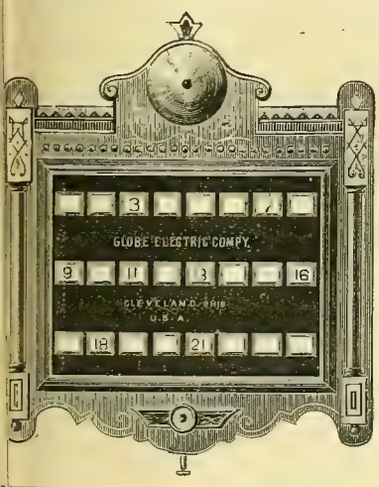

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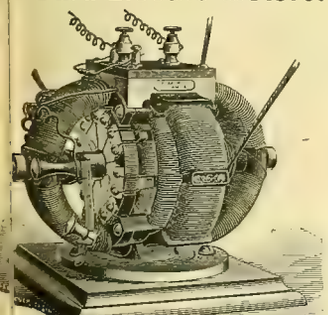

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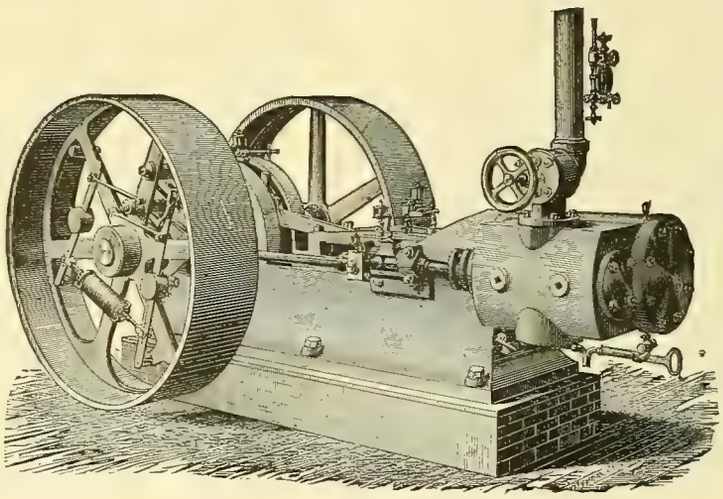

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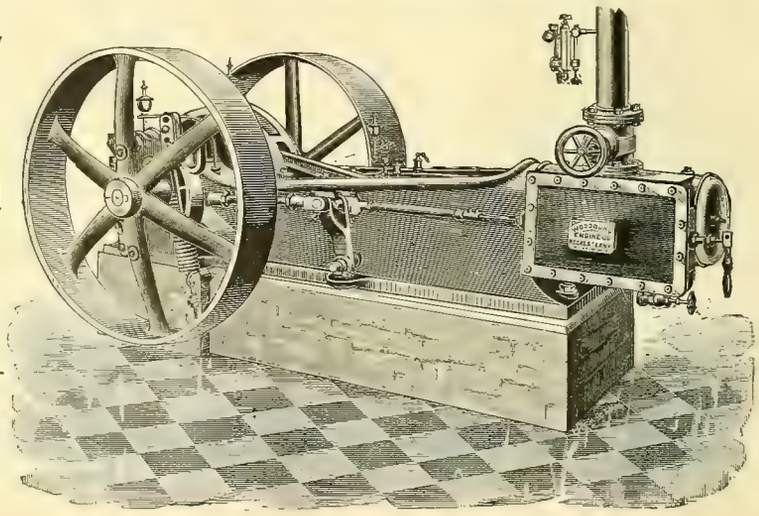

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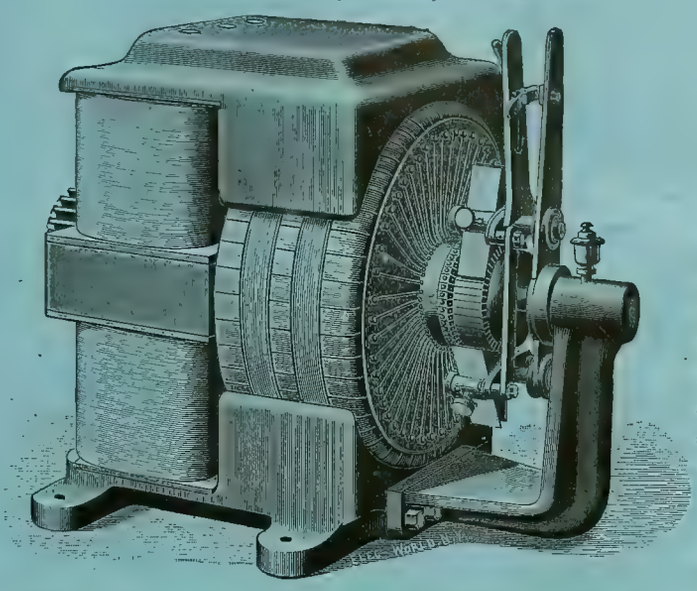

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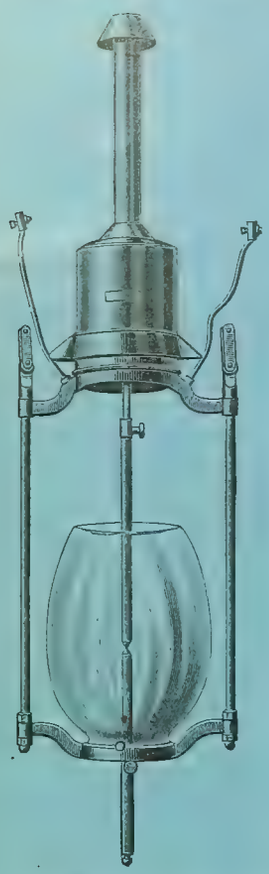

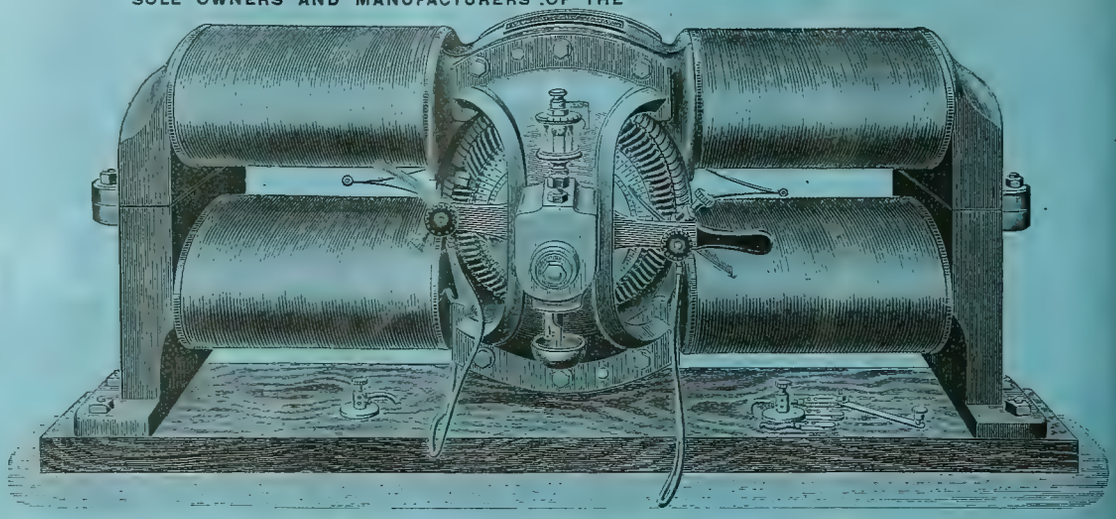

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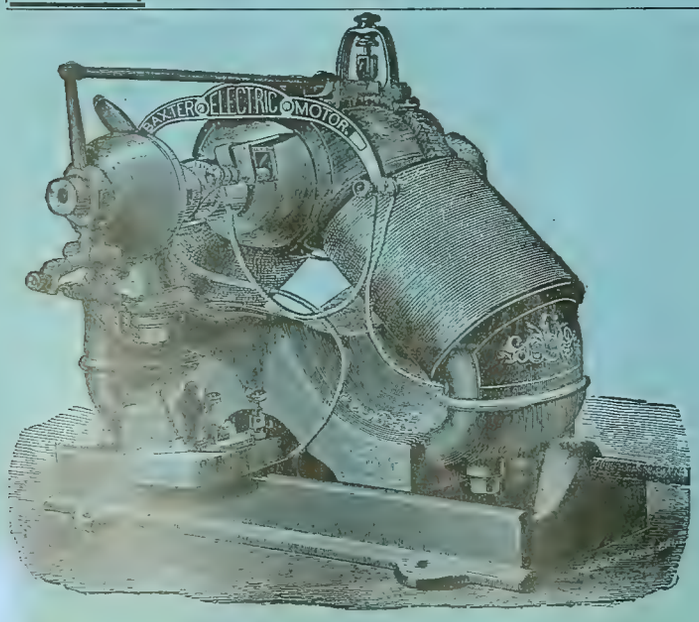

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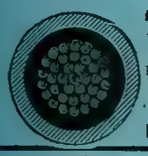

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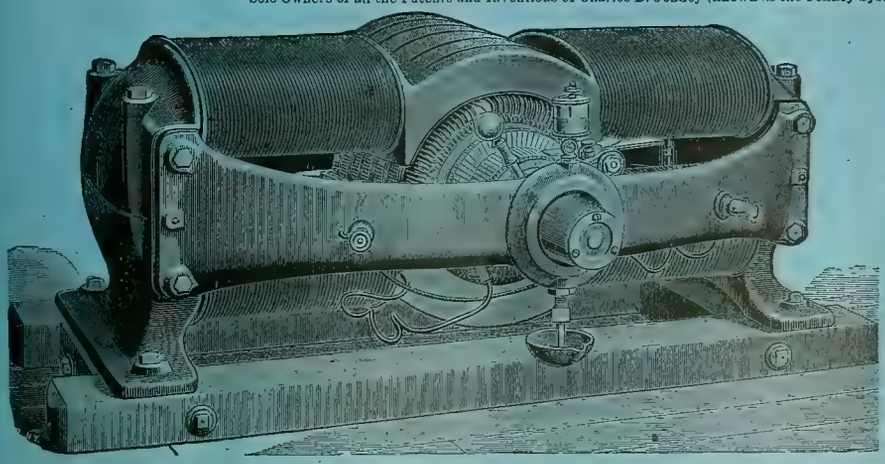

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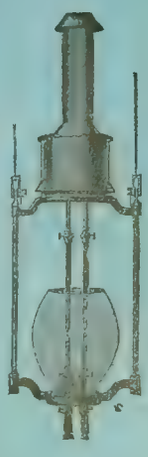

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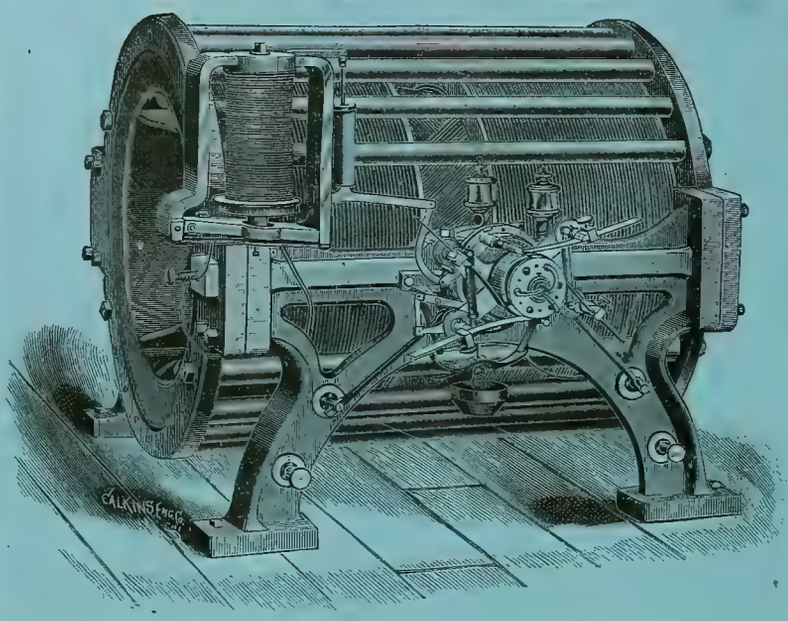

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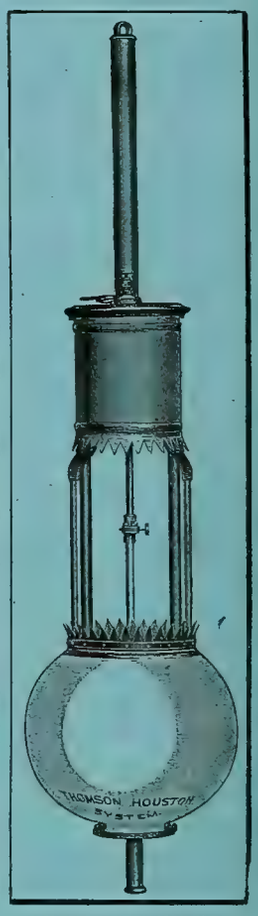

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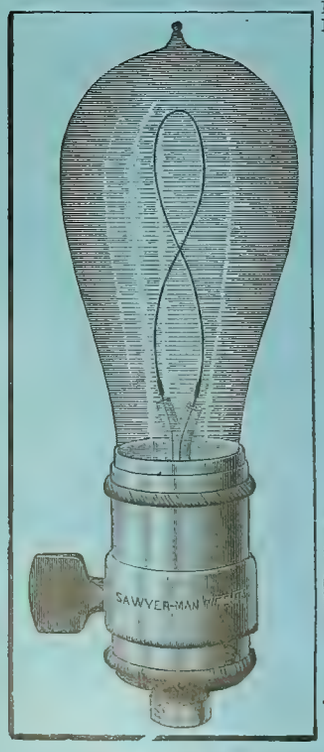

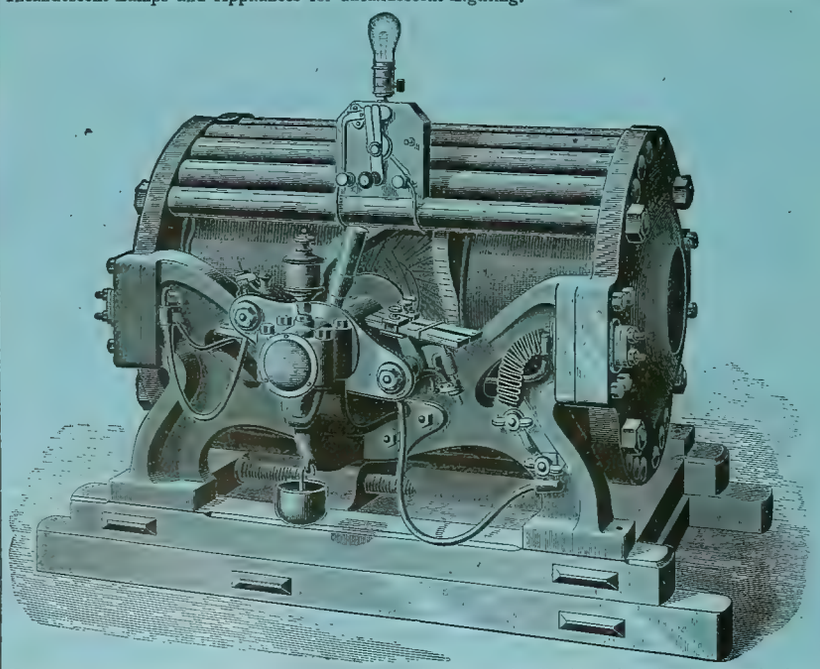

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Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

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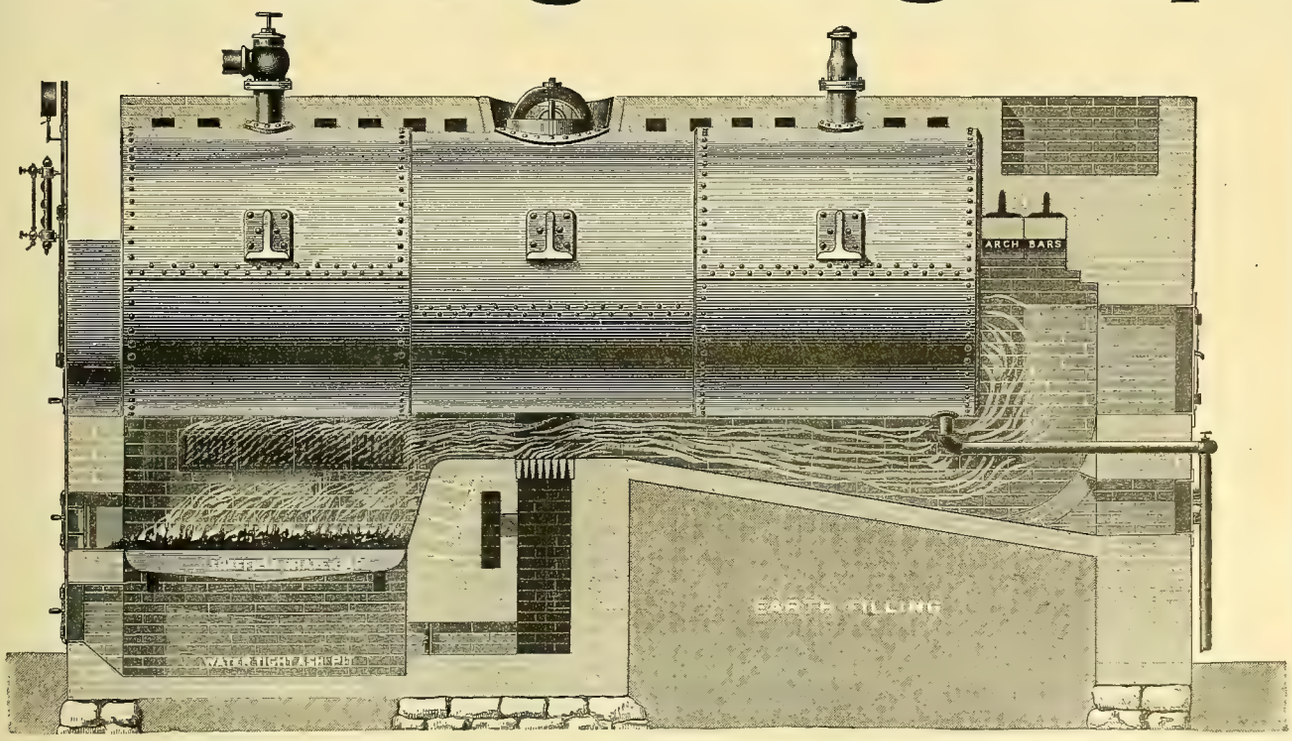

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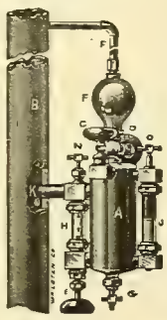
There will be a meeting of the CHICAGO ELECTRIC CLUB, Monday evening, November 21, at 8 o'clock, at the rooms of the Club, 122-124 Clark Street.



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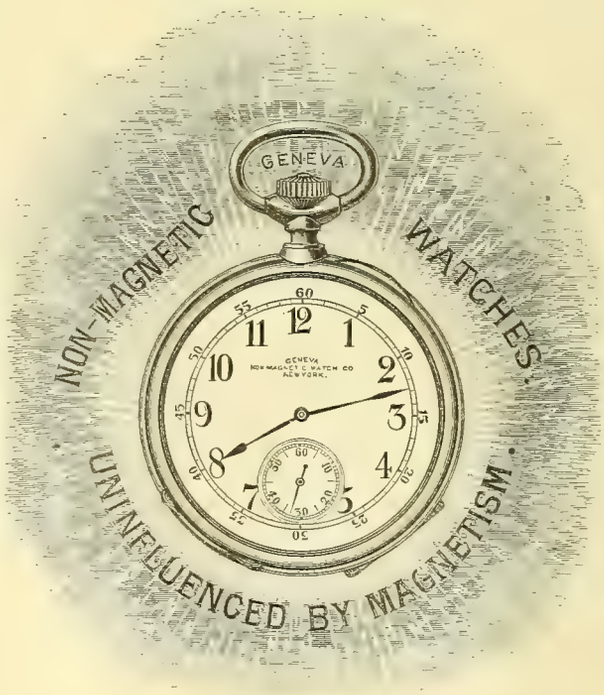

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Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

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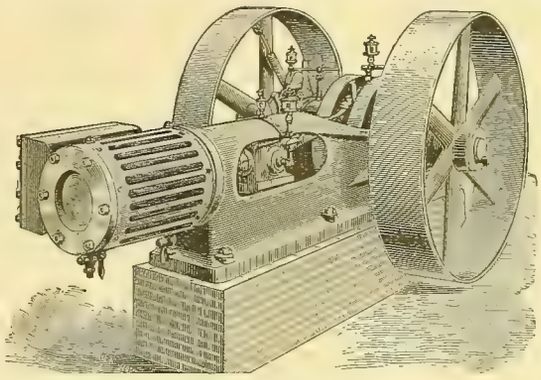

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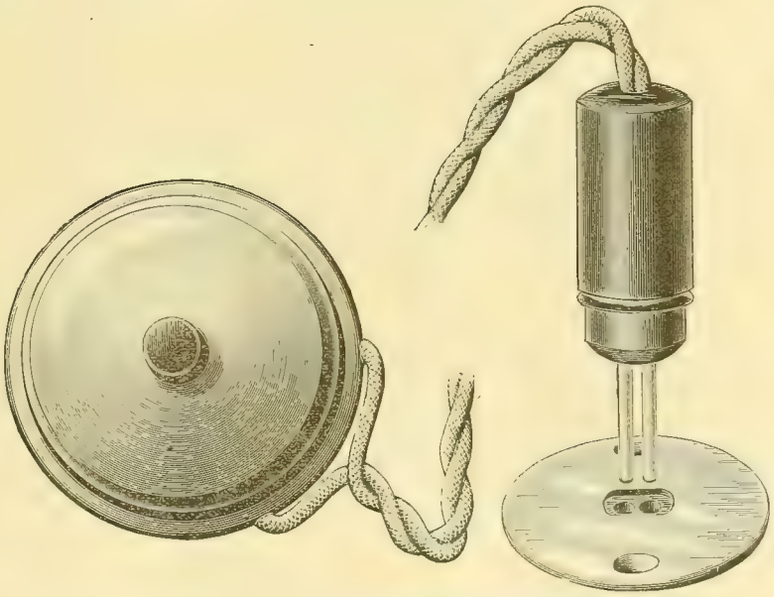

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Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT,
THE U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously insyalled by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 300 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C. C. Warren Esq
Dear Sir, I have written the answers opposite your questions above as per your request, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.
Yours truly, J. F. Conklin

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

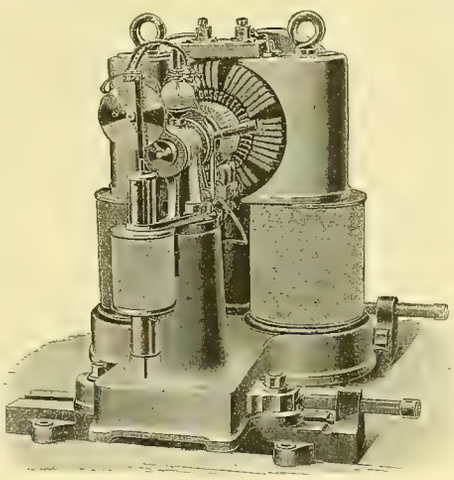
Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, NOVEMBER 12, 1887. No. 20

Constant Current Dynamo.

Although English electricians have reason to be proud of their achievements in the field for incandescent lighting, they have, up to the present, been totally eclipsed by their American rivals in the construction of arc light machines. We do not deny that English-made machines have been used successfully for arc lighting, but no firm on this side of the Atlantic has yet developed a complete and efficient system of arc lighting plant which could compete either against the Weston, the Brush, or the Thomson-Houston system, candidly admits *Industries*, our English contemporary, in prefacing a description of the constant current dynamo shown on this page. The great want in connection with arc lighting is a dynamo giving an absolutely constant current through a variable external resistance and when driven at a variable speed. A new machine of this description has been brought before the English association by Mr. Trotter, but as this has not yet been adopted in practice, it is impossible to say how it will fulfil the requirements of arc lighting. Mr. Trotter's method is only applicable to machines having a double horseshoe field magnet, and he obtains the necessary variation of e.m.f. by means of his electric governor actuating a rheostat inserted in the exciting circuit of one of the horseshoes only, so that this may form a more or less open path for the lines of force created in the other horseshoe. Another method for obtaining regulation, which we believe was first used in the original Hochhausen machine, consists in altering the position of the brushes. It is evident that the external e.m.f. is a maximum when the brushes are placed on the neutral diameter, and that it will decrease to zero as the brushes are shifted to a position at right angles to the neutral diameter. In the Hochhausen machine a small electro-motor was employed to adjust the brushes, but in the later "Wood" machine, also of American origin, where a similar system of regulation is employed, the brushes are shifted by frictional gear driven from the spindle of the dynamo. There is a wheel placed between the inner and outer circumference of a friction ring, and a solenoid controls the contact of the wheel with either the inner or the outer ring, thus causing the latter to revolve in one or the other direction. This motion is then transmitted to the brushes. Theoretically speaking, the shifting of the brushes is a much more perfect and direct way of regulating the e.m.f than the alternative method of varying the strength of the field, because the latter always takes considerable time, owing to what may be termed magnetic sluggishness. But there is the great practical objection of heavy sparking when the brushes are not on the neutral diameter. In order that a machine may run without any sparking, it is necessary that during the time when each coil of the armature is short-circuited by the brush, the current in this coil should be brought to zero and reversed, so that it may attain the same strength as the current in the preceding coil at the moment when the corresponding commutator plate leaves the brush. The reversal of the current is brought about by the influence of the field upon the armature, that is to say, a certain number of magnetic lines of force must be cut by each coil during its period of short circuit, and this number should be a constant for all positions of the brushes. In machines, as usually constructed, this condition is not fulfilled. The strength of the field is generally greatest at the polar diameter, and between this and the edges of the pole pieces it varies in a more or less complicated manner, the variation being partly due to the disturbing influence of the armature itself. If it were possible to shape the pole pieces in such a way that the combined field of magnet and armature is evenly distributed all round the circumference, the difficulty of sparking would be at once overcome. An attempt in this direction has been made by Mr. Statter, in the dynamo of which we herewith give an illustration. The original strength of the field in the neighborhood of the polar diameter has been reduced by cutting grooves in the face of the polar cavity at that place, the exact position and size of such grooves having been determined experimentally. The same object might have been attained by making the polar cavity not circular, but shaping it to such a curve that the air space becomes greater where the field would otherwise be too strong. Automatic regulation in this machine is obtained by means of a solenoid in the main circuit. The core of the solenoid is connected with a double pawl kept rocking by a connecting rod and eccentric pin on the end of the dynamo spindle as shown. There are two ratchet wheels side by side, but with the slope of the teeth in opposite directions, one for each pawl, and according as



the current is greater or less than the normal amount, one or other of the pawls engages and turns the double ratchet wheel forward or backward, this motion being communicated by a pinion and segment to the brush holder. We had had recently an opportunity of seeing this machine at work. It was driven from a portable engine with an indifferent governor, so that the speed was not absolutely constant; but as this system is intended for use with variable speeds, the imperfection of the governor is not a matter of importance. The average speed of the dynamo was 570 revolutions, and the following are some of the readings :—

External Current. Ampères.	*External Pressure.* Volts.
9.9	0
9.75	54
9.6	100
9.6	150
9.55	185
9.25	234
9.4	372
9.2	489
9.6	582

It will be seen from these figures that although absolute constancy of current has not yet been obtained, the result is fairly satisfactory. The total weight of the machine is 1,750 pounds, the field magnets are cylindrical, 7 inches diameter, and the armature core is 12 inches diameter by 10 inches long, containing 34.5 square inches of iron in cross section. It is wound with forty-eight coils of .057 wire, with sixty-three turns per coil. The resistances cold are : Armature, 5.1 ohms ; field magnets, 1.25. The exciting power applied to the field magnets is about 15,500 ampère turns to each limb, or 31,000 ampère turns in all. The external circuit on the occasion of the tests above recorded consisted of iron wire resistances, an arc lamp, and a number of Bernstein incandescent lamps, all placed in series, and so connected with short circuiting switches that the total resistance of the external circuit could be varied at will.

The Bell Cord Done Away With.

Nathaniel Banks Cregier of Chicago, son of Superintendent D. C. Cregier, has devised an electrical system of communication between the coaches and locomotive of a railway passenger train. In the system the use of a battery is done away with, its place being taken by magneto call bells. The intention is to place as many magnetos as are desired in each coach and one in the cab of the locomotive. By prearranged signals the conductor, trainmen, baggage or expressmen can communicate with the engineer, or *vice versa* if the latter has occasion to do so. The connections between the cars are made in a very neat and deft manner, and are so arranged that, if connection is made at all, it is made in a perfect manner. Further, the circuit is always complete. The act of connecting one car with another, or with a locomotive, throws the two thus joined into one circuit, while the act of disconnecting does not leave the circuit open, but makes it complete within any particular car. The object is obvious. No attention has to be paid to the circuit at the rear end of the rear car of a train for instance. As might be inferred, very little skill is demanded for either making the connections or using the system. As a whole, the system is exceedingly simple and far from expensive. There seems to be a field for such an invention, and there is a future of promise ahead of the inventor.

St. Joseph Electric Club.

An electric club has been organized at St. Joseph, Mo., with the following officers : W. C. Stewart, president ; Wm. G. Hall, vice-president ; W. H. Taylor, secretary ; J. M. Austin, treasurer.

The following have subscribed as members of the club : W. C. Stewart, Chas. O'Ferrall, W. M. Yenawine, J. H. Parker, A. M. Morey, W K. Robinson, W. G. Gaston, Joseph A. Corby, G. M. Mohl, I. T. Dyer, Wm. M. Glenny, Ed. Browne, M. B. Merriman, G. W. Harris, B. H. Barrows, Chris. L. Rutt, Theo. Steinacker, Ed. Henderson, P. J. Kirschner, A. P. Busey, W. B. Davis, Charles D. McCranor, J. M. Austin, Carlos S. Mitchell, W. G. Hall, P. J. Leonard, J. C. Howard, M. L. Seip, B. I. Young, A. H. Stewart, O. W. Teigh, A. F. Parker, Thos. H. Elfred, W. H. Roper, J. Lavin, Jos. Hansen, R. E. Turner, M. G. Atwell, H. H. Miller, A. G. Smart, C. A. Fleming, C. R. Berry, J. L. Rogers, Robt. Grief, R. Martin, M. J. Donnelly, A. H. Hunter, W. J. Hilton, W. H. Harrison, K. M. Mitchell, William Fink, Henry Jeungst, H. W. Taylor.

In Salina, Kan., 600 incandescent lights are already contracted for, while Abilene, Kan., is burning 800 lights.

A B. & O. Reminiscence.

Coeval with the birth of the telegraph in America, was that of the Baltimore & Ohio Telegraph company, whose recent absorption by its great competitor, the Western Union Telegraph company, is still fresh in mind. In connection with the portrait of Robert W. Garrett, the last president of the B. & O., a reminiscence is in order.

Professor Morse's efforts to secure an appropriation from congress to test the utility of the telegraph, are matters of well-known history. By a scant majority of eight, that body voted an appropriation of $30,000. But after the appropriation was made Professor Morse found little encouragement. Timidity and incredulity met him at every step. At last he appealed to Louis McLane, then at the head of the management of the Baltimore & Ohio railroad, which, in 1843, was the only railroad entering Washington, and the only direct route between Baltimore and the capital. The matter was carefully discussed and well weighed. April 5th, 1843, Professor Morse made a formal application to the company for the privilege of laying wires; conservative directors were unbelievers in the utility of the scheme, but finally they were induced to pass this motion, which, it will be noted, most carefully protected the company: "*Resolved*, That the president be authorized to afford to Mr. Morse such facilities as may be requisite to give his invention a proper trial upon the Washington road; provided, in his opinion, and in that of the engineer, it can be done without injury to the road and without embarrassment to the operations of the company, and provided Mr. Morse will concede to the company the use of the telegraph upon the road without expense, and reserving the right of discontinuing the use of it, if upon experiment, it should prove in any manner injurious." The latter clause will provoke a smile on the part of those who thoughtlessly peruse it, but, upon reflection, there will be the conviction that, instead of irony at such short-sightedness, there should be praise at the nerve displayed. Electricity forty years ago was not so readily trained as now, and the majority of persons would no more get in its immediate vicinity than to-day would they court close association with dynamite. Many a luckless experimenter had suffered from ignorance of results from certain combinations, and it is hazarding little, if anything, to state thousands believed it a satanic agency. The fact was, precious few knew anything whatever about it, and there is not, even at this enlightened stage of progress, half as many persons wholly incredulous as to the ultimate success of air ships as there were people not many years ago who believed telegraphy a nonsensical proposition. Mr. McLane himself indicated a not over sanguine conviction of the outcome when he said, in advocacy of favorable action, "Whatever may be our individual opinion as to the feasibility of Mr. Morse's invention, it seems to me that it is our duty to concede to him the privilege he asks, and to lend him all the aid in our power, especially as the resolution carefully protects the company against all present or future injury to its works, and secures us the right of requiring its removal at any time."

That Morse originally contemplated stretching the wires in the air is to be doubted, although some authorities claim this was his initial idea, and the underground plan a second thought. There are still living quite a number of railroad employes who remember the preliminary proceedings, and who were frequently in consultation with Morse himself, as well as those engaged with him in the work. They all agree the matter of poles was not mentioned at first, and the discussion confined to the underground plan. Mr. Latrobe says the line was to have been laid in a trench dug in the road-bed, and in none of the reports where mention is made is the question of poles referred to. The probabilities are the stretching of wires above ground was not considered until the plow with which the trench was made, not upon the road-bed but on the company's right of way, reached Relay and the viaduct at that point. Here it was impossible to continue, as the viaduct was of stone, and, as a matter of course, not to be ploughed. The carrying of the line so as to be out of the reach of the curious and the mischievous, necessitated its being run over the viaduct on raised rods or poles. However, before this emergency arose, the buried section became practically useless, as the current could not be maintained, and all the money spent—some $12,000 of the $30,000 appropriated—as good as thrown away. The plow, by which the line was laid from Baltimore to Relay, was a ponderous implement, showing no ordinary ingenuity in its construction. It made a furrow two inches wide and twenty inches deep, feeding the leaden pipes, in which the wires were encased, from the bottom. On top of the beam of the plow was a cylinder, holding some sixty feet of the pipe, which uncoiled and passed down over little pulleys in the rear edge of the blade of the plow to the earth cutting line, as heretofore stated. A plumber with his fire-pot and soldering irons followed immediately in the rear, and as the supply on the cylinder ran short, would step up, wind on a new section "wipe," or join the ends, and thus keep up the operation of laying the line. The propelling power was in sixteen immense oxen, and the "Whoa, there," "Gee you," and like commands not unmixed with imprecations, together with the novelty of the whole affair, created no no end of excitement for the denizens of the country traversed.

Robert Garrett.

The complete model of the Morse plow was on exhibition in the Baltimore & Ohio display at the New Orleans Exposition, and it attracted no ordinary attention. There was also in the exhibit in the Crescent City a model, showing the construction of the original Morse line after the trench plan had been abandoned. To establish the electric current, a wire connecting with the pole of the battery was soldered, in Baltimore, to a sheet of copper five feet long, two and a half feet wide, and thrown into the harbor. A like copper plate was buried under the pavement in the dry dust of the cellar of the capitol at Washington. To-day the wire is grounded anywhere without ceremony. Despite the faulty construction of the line, and its attendant mechanism, it worked, and thus settled, forever, the question as to Morse's theories being based upon the solid foundation of true genius, and not, as so many wise ones had so persistently insisted, the illusions of a weakened brain.

On the 24th of May, 1844, the line between Baltimore and Washington was completed, and, with the recording instruments in the Baltimore & Ohio Railroad depot in the one city, and in the supreme court chamber in the other, the first formal dispatch ever forwarded by telegraph was sent over the line. "What hath God wrought" were the four memorable words.

In 1858, John W. Garrett was elected to the presidency of the B. & O. company, and was succeeded by his son, Robert Garrett, in 1884. The son was born in Baltimore, April 9, 1847. When only 24 years of age, Robert Garrett was made president of the Valley Railroad company, owned by the Baltimore & Ohio, holding that position until 1875. In 1879 he was elected third vice-president of the Baltimore & Ohio company, and two years later first vice-president, succeeding to the presidency on the death of his father in October, 1884, as stated above. Directly after retiring from the presidency a few weeks ago, Mr. Garrett started with a few intimate friends and his physicians for an extended tour to the Northern Pacific coast, and thence to California and Mexico.

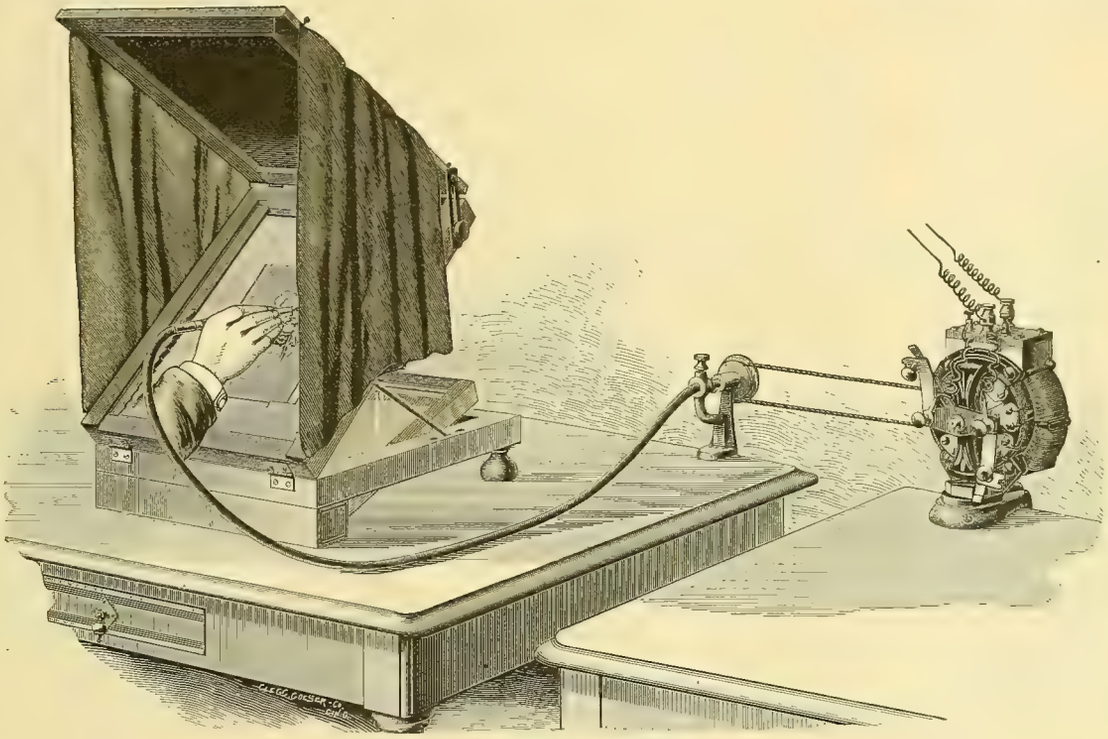
An Electric Launch.

Trials have been made at Havre with an electric launch built to the order of the French government by the Forges et Chantiers de la Mediterranèe. The vessel, which has rather full lines, measures 28 feet between perpendiculars and 9 feet beam, and is 5 tons register, says *Industries*. The electro-motor is the invention of Captain Krebs and M. de Zédé, naval architect. The propellor shaft is not directly coupled with the spindle of the motor, but is geared to it by spur wheels in the ratio of 1 to 3, in order to allow of the employment of a light high speed motor. The latter makes 850 revolutions per minute, and develops 12 horse power, when driving the screw at 280 revolutions. Current is supplied by a new type of accumulators made by Commelin & Desmazures. One hundred and thirty-two of these accumulators are fitted in the bottom of the boat, the total weight being about 2 tons. In ordering this boat the French government stipulated a speed of 6 knots to be maintained during three hours with an expenditure of 10 horse power. The result of the trials gave a speed of 6½ knots during five hours with 12 horse power, and sufficient charge was left in the accumulators to allow the boat to travel on the following day for four hours.

According to the patent the electrodes consist of amalgamated zinc plates and porous copper plates, the latter being produced by the consolidation of powdered copper under very great hydraulic pressure. The zinc plates form the negative electrode, and are in metallic connection with the box, which is also of zinc, while the positive plates are placed in vegetable parchment bags and suspended in the usual way. Contact with the negative plates is prevented by glass rods.

The Card Retouching Machine for Photographers.

A new light power use for the electric motor has been devised by George F. Card. The well-known action of a flexible shaft is supplied to the pencil used by photographers for this purpose. By this means the power is easily applied to the negative, held in the ordinary retouching frame seen in photographers' studios. A reciprocating motion is effected within the shaft, and by this device the pencil is driven in and out with great rapidity and at the same time with the greatest delicacy. The speed may be accelerated until 10,000 to 12,000 strokes per minute are placed at the command of the operator. This minute pressure upon the surface of the negative can be restricted until an extremely slow action results. It is therefore an apparatus entirely under the control of the retoucher. When he desires to replace a worn out pencil with a new one, or to change the grade of pencil used, he has merely to open a bayonet groove in the end of the shaft and substitute what he wishes in its place. The stroke is entirely free from vibration. The most unskilful retoucher is by this means able to attain any desired effect with a firm touch. Negatives retouched by its action are finished in much less time than is demanded by any other method. The power required is light, and a primary or storage battery is sufficient for the purpose. The apparatus is made by the Geo. F. Card Manufacturing company, of Cincinnati, and has very recently been perfected by the inventor.



The Card Retouching Machine.

The Effects of Electric Light Induction on Telephone Wires.[1]

By B. E. Sunny.

Ten years ago the telegraph held in its employes a monopoly of the practical electrical work of the country. All of wires and machinery belonged to the telegraph, except here and there a small amount of experimental apparatus which formed an insignificant part of the whole.

The telephone made its appearance for commercial purposes about that time, and from a small beginning it has grown until it now equals, if it does not exceed, the telegraph in the amount of capital invested, mileage of wire, and importance to the community. The telephone service was organized with a few telegraph men in its ranks, but the greater number of its employes came from the outside.

Following the telephone came the electric light, and in the short space of four or five years it can boast of a success that is simply astounding. Every city, town, and village of any importance, and many of mighty little importance, have found its benefits, and that the service is a fixture in the commercial world is beyond question. The telegraph and the telephone both contributed their quota of men to form the nucleus of what is now such a vast service; but, as in the case of the telephone, the majority of the men who allied themselves to the new industry, made their first bow to Messrs. Volt, Ampère, Megohm, and the other members of the family at the door of the dynamo room.

So we find that at the end of ten years the practical application of electricity is split into three great divisions, each entirely independent of the other; that a science, the salient points of which could be grasped in its entirety by the average mind, has broadened out and gathered about it so many new and wonderful features, that a man must spread himself out pretty thin indeed to cover the whole field. The result is that the electrical "cobbler sticks to his last," and the members of the three great branches of the work—each absorbed in his own allotted part—know only in a casual way what the others are doing, or what they are doing it with.

In considering the question of the effects of electric light induction on the telephone, the facts above stated warrant a brief description of the telephone, especially its extreme sensitiveness. Everybody is familiar with its construction, which is simply a permanent magnet, a spool of wire, and a metal diaphragm. The permanent magnet runs through the spool of wire, the latter connected with the line, and the diaphragm is placed so that it is within a small fraction of an inch from the end of the magnet. Now talk at the diaphragm, and it will move with the impulse of the voice; the magnetism in the permanent magnet is increased or decreased, or, you might say, is thrown out of balance by the pieces of metal approaching or receding. These changes are communicated by induction to the spool of wire, and out they go on the line and away off ten or fifteen miles where they are reproduced with fullness and accuracy. No battery is required to accomplish this. You simply shake up the magnetism that is held in a piece of steel four inches long, and it will give voice to your wants as well as you can; it will pray when you pray; it will hope when you hope; and I am sorry to say it will swear when you swear. Of course, the current which passes over the line is an infinitesimal one, and while it is sufficient to operate the instrument at a distant end of the line, no form of galvanometer up to a recent date was sensitive enough to be affected by its passage. I understand that Professor Cross, of Boston, now has an instrument that will detect the flow of a telephone current, but I am not familiar with it. A test that many have made is to get a balance on a bridge galvanometer, so the needle is absolutely at rest; take out the needle, and put in a telephone, and by opening and closing the key it will be found, by the click in the telephone, that there is current passing across the bridge; nor can a fine enough balance be secured to make the telephone perfectly quiet.

So much for the sensitiveness of the telephone, which it might be said is sufficient to reproduce sounds uttered on the other side of the globe, did not counter currents destroy them before they got well under way.

As has been explained, the disturbing of the magnetism in the permanent magnet generated induced currents in the spool of wire and the line, so that it is clear that the whole foundation of the telephone service is induction. If it were not for induced currents, there would be no telephone; yet the ridiculous fact remains that at some stage of his career every telephone man in the country has turned his mighty brain to the task of inventing an induction killer. Many a good man has gone wrong in his mad chase after this *ignis fatuus*. The immortal fame that must attach to the lucky finder of a method by which a telephone would be compelled to discriminate between an induced current which it was intended that it must record and an induced current from a telegraph line which it must not record, was an alluring decoy and an empty dream. The years roll on and the induction killers are dead. The wise second thought of the telephone man was that he must not try to destroy induction, the very soul of his business; but that he must not create any more than he can use, and must avoid that which he does not want. The result is that he is going into metallic circuits, and the induced current from one side of the line operates to augment the current on the opposite side. Where he does not use metallic circuits, and has long lines running parallel to each other, he changes their relative positions on the cross-arm, and the induced currents from a particular line are dissipated through the balance, and where the balance is made up of a dozen wires the induction felt on each is trifling. Again, where the induction comes from the telegraph, the only remedy lies in changing the route and getting away from it. These are the only practical remedies that have so far developed, the "induction killers" failing because they generally cut down the efficiency of the instrument, and make it a poor one, or they prove too good a

[1] Read before the Chicago Electric Club, November 7th

lightning arrester, and after each storm leave the line open in a dozen places.

The effects of telegraph induction on the telephone are very apparent on some of the long lines running out of Chicago, but are particularly so on the wires between Chicago and Joliet. The distance is forty miles. The telephone wires are on the south side of the Illinois and Michigan canal, and the telegraph is on the opposite side. The routes are two hundred feet apart, yet the induction is so heavy at times as to make talking impracticable. The induction from the telegraph is readily distinguishable from that from electric light wires in that the noise made by the telegraph is a succession of short, sharp impulses, while the electric light wire induces a hum that penetrates the exchange from one end to the other. An expert in the use of a telephone can talk through a larger amount of electric light than telegraph induction, because the former is steady and monotonous while the latter is very irregular. The first case of electric light induction on the wires of the Chicago company occurred perhaps four years ago. I had occasion to talk with our manager in Aurora—forty miles away—and called for the connection during the evening. After giving my order I stood waiting and listening, and shortly heard the operator say "put the saw

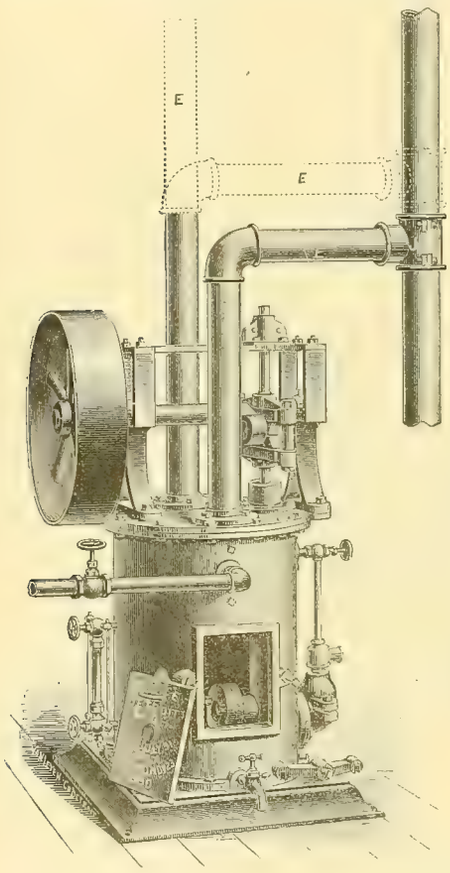


Fig. 1.—Combined Heater, Purifier and Pump.

mill on here"; immediately a veritable saw mill in full operation, judging from the noise, was presented to my attentive ear. The boys had noticed the noise the night before, but had not reported it. Their selection of a name was a happy one, but it occurred to me that the mill people were handling some pretty long planks. Investigation showed that an electric light plant had just been started in Aurora, and that the circuit paralleled one of our routes for a short distance. The induced currents reached the exchange on the wires of the exposed route, passed over the ground, which was a good one, and spread in every direction. The toll lines carried it to the Chicago exchange, and from there to the routes in Chicago carrying a wire that might be connected with Aurora. The wires in the Aurora exchange were rendered almost useless, subscribers not being able to talk to their neighbors a few squares away, and the Chicago wire was almost as bad. The Aurora and Elgin wires run parallel a long distance, and the noise penetrated the Elgin exchange, and could be distinctly heard on all the wires. By getting the electric light circuit changed to another route, the induction was so reduced as to be harmless. Another case occurred on a route along Milwaukee avenue. An electric light circuit was strung over the roofs, up one side of the street and down the other. This arrangement put the route midway between the two sides and gave us so much annoyance from induction at night that we were compelled to switch our Milwaukee wires at Oak Glen, using a route by the way of the lake shore into Chicago. The plant at Grenier's garden on West Madison street caused us great annoyance. The circuit did not come nearer than twenty feet to any of our wires, and the exposure was not more than two hundred feet.

A novel experience was met at the Union Stock yards a year ago. One of the packing houses having a large number of electric light and telephone wires, complained of the noise on the latter. We found many points of exposure to electric light induction and removed them, but the noise was still heavy on one wire. After much searching the chief cause of the trouble was found to be a slight cross between an electric light and a telephone wire, although they were several feet apart. The cross was made by a cloud of steam escaping from an exhaust pipe, which enveloped the two wires and served as a medium of communication between them. Upon taking the telephone wire out of range of the escaping steam, the noise was cut down very materially and noticeably. What was still left on the wire we could not locate, and among other tests, we made the following: The telephone was grounded by a rod driven into the earth just outside of the building. We took the line side out and put on another ground by using a steam pipe. The circuit now was from ground to ground through the set of instruments, and the distance between the two grounds was probably fifteen feet. The electric light induction still made a noise in the telephone, but not enough to interfere with conversation.

One of the most severe experiences that we have had occurred a year or more ago. There is an exchange at Englewood and another at Cottage Grove and Thirty-ninth street, and the toll line to Michigan City runs into both of them. I answered a call on the telephone at my house one evening, and through a most terrific electric light induction I heard fragments of conversation relating to fire somewhere. Then the exchange at Twenty-second street came in and cutting off the south end of the wire, stated that there was an electric light cross on the Michigan City line, and that it had set the cupola at Thirty-ninth street on fire. The noise was very heavy, but still we could talk through it. We promptly called up Englewood to get the wire cut out of that office, but the people there could neither hear nor be heard. It was the same at the Stock yards, and for that matter all over the city. The wires fairly hummed, and the excitement in the exchange where the operators tumbled over each other looking in cupolas, behind switchboards, and anywhere and everywhere for fiery evidences of a cross, was beyond description. In a few short minutes the noise had gone and the usual stillness on the wires was restored. The damage consisted of the destruction of the cupola where 150 wires entered at Thirty-ninth street, and the loss of annunciators at La Salle street and forty miles away at Chesterton, Indiana. The following morning at daylight the men started out tracing the wire, and they hunted from one end of the line to the other without finding any trace of an electric light wire near ours. We never found out where the current originated, and have no idea to this day. This case is mentioned more to illustrate the effects of paralleling electric light and telephone wires than for any other purpose, because it indicates how seriously the induction interferes with the talking, not only on the wires immediately around the electric light conductor but throughout the whole exchange. In this instance the Michigan City wire being crossed, was practically an electric light wire, and operated to the detriment of the other wires just as an electric light wire would.

There are many similar experiences that might be mentioned, but it is not necessary. The chief cause of the heavy electric light induction on the telephone wires no doubt comes from the practice of separating the sides of the circuits, one side going one way and the other side another. If on the other hand, the two sides are kept together, and are reasonably well insulated, there will not be induction enough to bother the telephone. A Pittsburgh experience will illustrate this point. The telephone company owned a heavy pole line on the north side of the street, and allowed one side of the electric light wire to be put on its pole below the lower cross arms. The other side of the circuit went along the opposite side of the street. There was some induction, but not enough to complain about. In making some changes, however, the electric light folks took down the side opposite the pole line, and moved it a block away. The induction from the wires on the pole immediately increased to such an extent that the telephone wires were badly injured. The circuit was changed back to its former position, and the trouble disappeared. There are many instances of the use of telephone poles for electric light circuits, where the sides are kept together, without any serious injury to the telephone service resulting. On two occasions we have extended the privilege to private parties in Evanston, to run an electric light loop on our poles for a half mile or so, to furnish arc lights for a lawn concert. During the two weeks that this circuit was in use no particular annoyance from induction was felt. The two sides of the circuit were eighteen

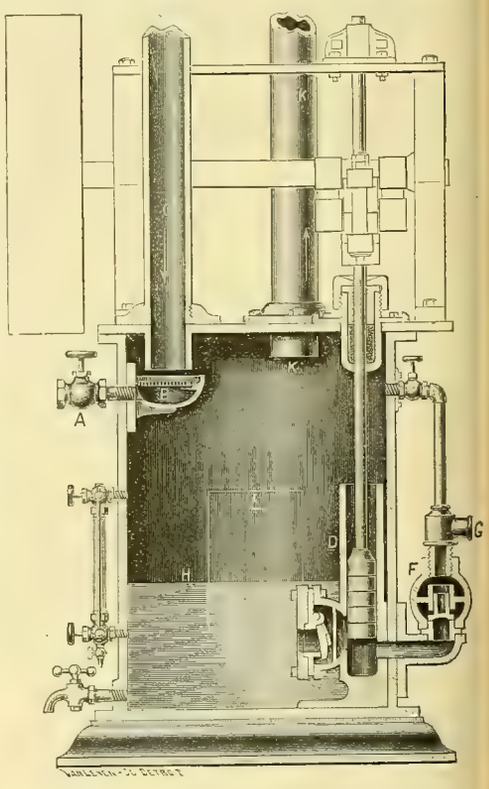


Fig. 2.—Combined Heater, Purifier and Pump.

inches apart, and they induced into each other; and on the presumption that the insulation from the earth was reasonably good, there was no reason why any induction should get to the telephone wires, which were six or eight feet above. The danger from crosses is so great, however, that the arrangement is inadvisable. Not only is it dangerous because of the possibility of destruction of property by fire from crosses, but it is a constant menace to the lives of linemen.

There are two points that I think can be made in connection with the relations between the electric light and the telephone. The first is, that there are too many quarrels requiring settlement in court. Three or four years ago affidavits were made up by the telephone officials citing that the close proximity of electric light wires to the telephone is a danger and a damage to the latter; and to my personal knowledge copies of those affidavits have done service in many states, and the demand for them is not quite over. In most of the cases where injunc-

tions are asked, the electric light men have paralleled the telephone routes, or were about to do so, without knowing what a great injury it would work to the telephone. The outcome of the legal contest generally compels the removal of a line of poles and wire to another route which means expense, loss of time, and income. With a full realization of the effects of electric light induction on the telephone, and a reasonable

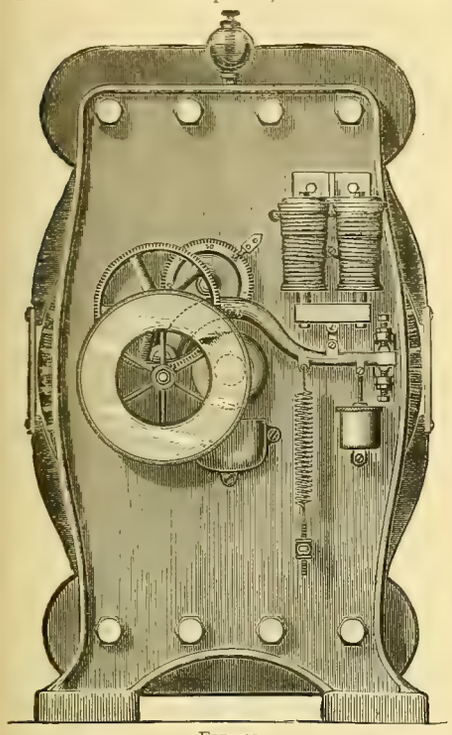


Fig. 50.

regard for the property rights of others, I do not think that these quarrels ought to occur. There are certainly no reasons why the telephone people should desire to keep an electric light company out of a city or town, if its admission will not injure the telephone plant. No motive other than that of self-preservation should move the telephone people to stop electric light construction, and wherever such steps are necessary, the results desired ought to be secured without going into the court. The two interests are closely allied—they are brothers, or cousins, or something to each other—and a lack of harmony between them must look to the outsider like any other family jar, a very disagreeable spectacle. More co operation and fewer injunction suits should be the fashion. The second point is with regard to the arrangements of wires where routes cross each other. It is the usual thing to put an electric light wire under thirty or forty telephone wires, while to my mind the better plan would be to put the electric light wire on top. The reasons in favor of the plan are that the one electric light wire is not liable to break or fall down, but will remain in good condition for years. The telephone wires are of iron, and are apt to break from cold, sleet, or flaws. Things being equal as to the quality of the wire used, the method that I suggest is the better one, thirty to one, as a preventive of crosses. As an extra precaution, the top cross-arm of the telephone pole should be filled with guard wires open at the ends, so that if the electric light wire should fall, it would not come in contact with a telephone wire.

Combined Heater, Purifier and Pump.

The value of having feed water for steam boilers as hot as possible before it enters the boiler, is so universally recognized that it is needless to dwell upon it, and there are very few first-class steam plants not provided with heaters of some kind. Again, especially in sections of the country where the water is laden with other matter either in suspension or solution, purifiers are largely used in order to reduce the amount of scale making matter carried in the water to a minimum before it enters the boilers. As a rule, the steam plants of electric light stations of recent installation are provided with these accessories, which are looked upon not as luxuries by any means but as economical devices whose use will reduce the cost for maintenance to the lowest point possible. The combination of feed water heater, purifier and power pump shown in Figs. 1 and 2 on opposite page, is a novel one, and shows in one compact device three essential elements to every first-class steam plant. The apparatus is sold by Frank M. Clarkson, Detroit, Mich. The pump is run by a belt from shafting. It is of the ordinary plunger variety and actuated by a crank and yoke. Its simplicity guarantees its durability. Fig. 1 shows the apparatus in perspective. In Fig. 2, A represents the feed water inlet; B, a spraying plate; C, the exhaust from the engine; D, the pump; E, the suction valve; F, the outlet valve; G, the pipe to boiler; H, the water level; K, the exhaust from heater and L, the door.

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number XVII.

The Wood Dynamo.—This dynamo, which is a reconstructed form of the Fuller dynamo, will be readily understood from Fig. 49, without any detailed description. It is of the Gramme type, embracing the recent features of ventilation of the armature, and automatic current regulation, but presenting nothing in its construction which has not already been fully described in these articles, except the current regulator. This is illustrated by Figs. 50 and 51. Fig. 50 is an end view of the dynamo showing the apparatus in full, and Fig. 51 a side view of the same end, showing the connection with the brushes; the automatic shifting of the brushes on the commutator to vary the electric intensity being the object to be accomplished. The large friction wheel shown in Fig. 50 has a broad rim with a deep groove on its inner surface next the dynamo. The end of the armature shaft fits loosely into this groove, as shown by the dotted circle on its right side, but is out of contact with the wheel in the normal state of the current. This friction wheel is connected at its center with the short arm of the curved lever shown in the cut. Above the lever on the right movement and makes it gradual instead of impulsive. A pinion on the hub of the friction wheel engages gearing connected with the yoke to which the brushes are attached, as shown in Fig. 51. The magnetic attraction acting against the retractile force of the spring is just sufficient, in the normal state of the current, to hold the lever in such a position as to keep the friction wheel out of contact with the revolving armature

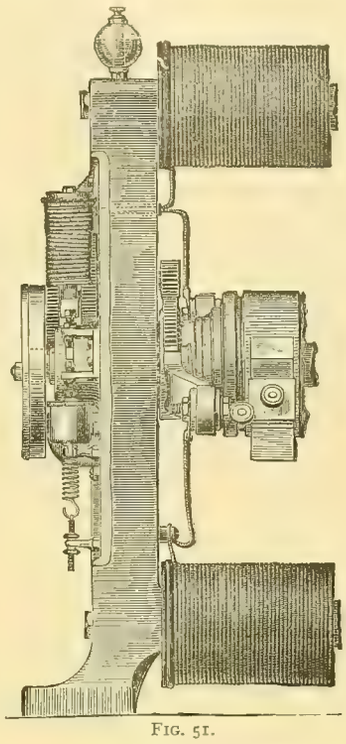


Fig. 51.

shaft. An abnormal increase of current increases the magnetic force, which attracts the armature and raises the lever, which presses the friction wheel against the revolving shaft on one side of

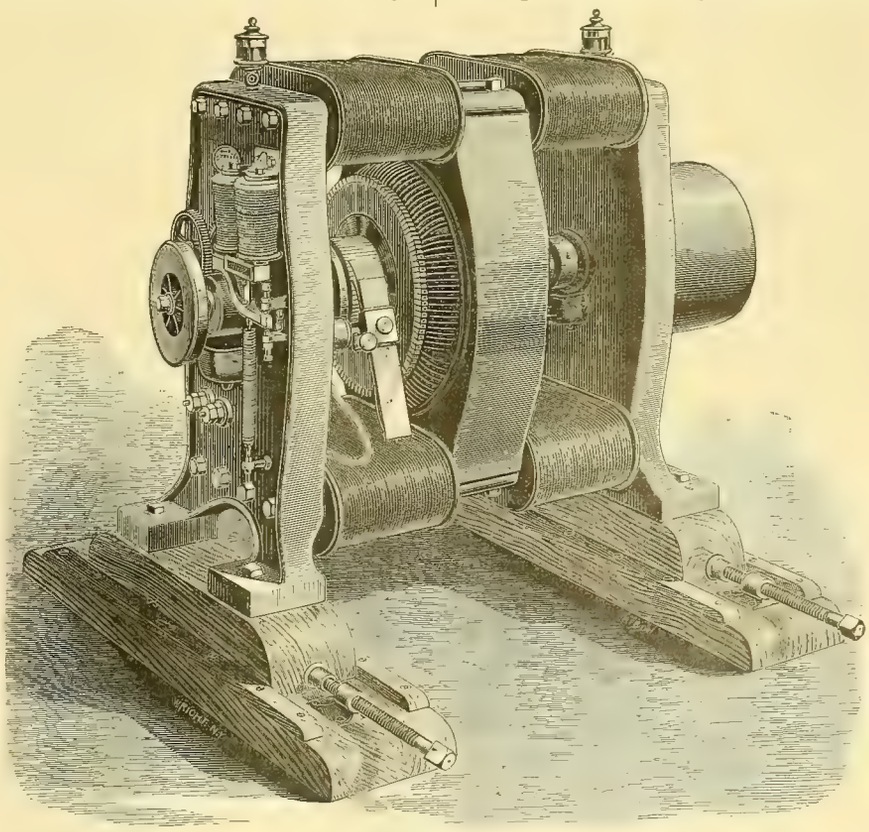


Fig. 49.

is shown an electro-magnet, connected with the lamp circuit, the armature of which is attached to the long arm of the lever, and below it is a spiral spring which acts against the magnetic attraction. Two stops at the extremity of the long arm limit its movement, and a dash pot, which consists of a piston moving in a cylinder against air, or other resistance, steadies the the groove, and by means of the gearing causes the brushes to recede from the line of greatest intensity. An abnormal decrease of current lessens the magnetic attraction, the lever is drawn down by the spring, the friction wheel pressed against the opposite side of the groove, the motion reversed, and the brushes made to approach the line of greatest intensity.

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POPULAR lectures on electricity at one penny admission per lecture, and short courses of three lectures each is the new departure in the extension of university teaching in London the present season.

PROFESSOR BARRETT, city electrician, is still at work on the estimate of the cost of lighting a large portion of the business center of Chicago with the electric light, the city to own and operate the plant, and will not have his report ready to submit to the council for some weeks.

At the meeting of the city council of Chicago Monday evening last Alderman Ernst presented orders for ordinances requiring that hereafter all telegraph and other wires be required to be laid through alleys where practicable, and that permits for the same require that the work be done at night. The matter was referred.

IN regard to the proposed postal telegraph, the assumption by leading public journals that it could never to any extent be made subservient to party political purposes, is undoubtedly correct. Under the civil service act, a strict examination of all the employes would be required, and none could enter the service unless properly qualified; and as such qualification is more difficult of attainment than that required for the postal service, the number of applicants would be proportionately limited. In the choice of superintendents in the cities there would probably be some chance for political favoritism, as in the case of postmasters, since the superintendent in such a position need not be an expert.

THE methods pursued by existing gas companies in Chicago are subjected to severe strictures in the editorial from the Chicago *Times*, republished on another page, and furnish interesting reading.

The conclusion that gas as an illuminant is far in the rear of electricity is one that is so plainly evident after a comparison that it admits no question. It is also argued that it would be more for the city's interests if the city owned and operated the plant that furnished lights to its streets. Although the analogy is not cited in the article in question, those most strongly in favor of municipal ownership and operation of the sources of its own illumination settle the discussion in a few words: "Cities control their own water works and why not their own lighting plants." This analogy is a strong argument it must be admitted. Further, Chicago already owns one electric light plant for lighting the river bridges and approaches, and it was decided after due consideration that it would be more economical for the city to own and operate this plant than to rent lights from a private company, and there is no reason why the city should not own and operate a plant or plants that would light a much larger territory than that included within the limitations of the river lighting plant.

WE give this week a description of an English dynamo which presents some novel features; the form, as shown by the cut is quite unique, and very different from that of any dynamo, either English or American, with which we are acquainted, the field magnets being both mounted on the base, and projecting vertically, with the pole pieces inclosing the armature above them. It is claimed that sparking at the commutator would be overcome by an even distribution of magnetism in the field, and that this has been accomplished approximately by grooving the pole pieces in the center, at the point of greatest magnetic intensity, and thereby reducing the intensity to correspond to the intensity at the edges.

Automatic regulation is effected by shifting the brushes in the usual manner, by means of a double pawl which engages two ratchet wheels which move in opposite directions as described, and operated by a solenoid placed in the electric circuit.

Our English contemporary, from which the article is taken pays a high compliment to American dynamos which is undoubtedly well deserved

THE agitation in favor of rapid transit, especially on the west side in Chicago, is increasing. Elevated and underground roads, as well as cable lines, each have their strong advocates. Chicago has outgrown horse cars, and each succeeding year more and more discontent is expressed at the slow locomotion afforded by them, and that discontent is greatly heightened in winter by the attendant discomforts of cold and crowded cars. The south side is provided with several cable lines; a cable line on the north side has been laid and is expected to be in running order before many weeks; and it is expected that a cable line will replace some of the horse car lines on the west side. Nevertheless, while cable lines are much preferable to horse car lines in every respect, and while they are more rapid, they still fail of providing that rapidity of transit desired by those whose homes and whose places of business are at a distance from each other. This is the view taken by those who desire an elevated road. But an elevated road run by steam motors is subject to many objections on account of escaping steam and the other annoyances which accompany a steam motor on or above the surface of a street. On the other hand, an elevated road, as has been pointed out before, with electric motors, would give rapid transit, and could not be objectionable to either residents of streets, pedestrians or owners or drivers of horses. The system of transmission could be overhead, or by a third rail, or by a conduit placed below the level of the rails, or in any manner provided for by electricians without being the source of complaint on the part of any user of the street.

A VERY interesting statement of facts in regard to the effects of electric light induction on telephone wires is presented in the paper read by B. E. Sunny at the last meeting of the Chicago Electric club. The great importance, in a business point of view, of harmony between the different departments of electric business, represented by the telegraph, the telephone, and electric light and power, is shown by the effects of induction on each other's lines, in many cases entailing serious loss and injury, and leading to litigation which could be avoided if the electric experts in each department would inform themselves thoroughly, not only in the technicalities of their own departments, but also in regard to their relations to the other departments. In fact, an electric expert ought to be a thoroughly informed electrician in all the departments, and to understand fully the principles of electricity in all its various applications. But in too many instances this is not the case, and the deteriorating effects of induction in adjacent lines, or the danger to life and property from fire or electric shocks, are becoming more common as lines multiply. The telephone department seems to be the greatest sufferer, on account of the extremely light current required, and its great sensitiveness to inductive effects; so great is this sensitiveness that on a line 40 miles in length, an adjacent telegraph line 200 feet distant produced serious disturbance. The advantage of metallic circuits with opposite currents on adjacent lines, by which inductive effects shall be mutually helpful instead of detrimental is being recognized and adopted. The paper is highly practical and suggestive.

THE Chicago Electric club is a young but vigorous organization. It was incorporated last May, and the earlier meetings to perfect its organization, were held in June. A summer notable for its abnormal heat followed. Interest lagged and the work laid out for the summer months was necessarily postponed until fall. Practically all the work of the club towards increasing its membership and providing itself suitable rooms, has been done since the middle of September. At the meeting last Monday evening it was announced that the membership roll numbered 163 names, which, it must be admitted, is a handsome showing under the circumstances. The rooms of the club have been described in these columns, but they speak better for themselves than words can. Suffice it to say, they are convenient of access, handsome in appearance and well equipped. The feature of the café is one to be commended and one that has received its due share of attention, judging from the use that has already been made of it.

It is not well to demean the character of the club by placing the social element in priority to the literary and scientific element. But the papers that have been read before the club, and the discussions that have followed them, need no words of praise. They stand for themselves and any close reader of the papers is bound to admit that as contributions to electrical literature they are deeply interesting and very valuable. No set course of papers has been laid out, yet the range of dissertations has been wide and the indications are that the limitations of that range will not be reduced. Chicago and western electricians should feel proud of the club, its accomplishments and its future.

THE suggestion made by our esteemed contemporary, *Electrician* of London, to form an association the other side of the water similar to that of the National Electric Light association on this side, has been received very favorably by British electricians. The columns of both *Electrician* and *Industries* teem with views of correspondents, and other technical papers lend their influence to the movement. After considering the societies with which the proposed association might possibly clash, *Electrician* says: "After expressing ourselves thus frankly and in full accordance with the great majority of the opinions which have been expressed to us by those chiefly interested, it will, we trust, be perfectly clear that the objects of the proposed Association of Electrical Engineers are of a purely business character. To protect their own interests, to promote their own industries, and to discuss the best means of securing these ends, would be the foremost objects of its members — objects which will be none the less easily attainable for being openly avowed. Some of these industries are hampered by legislative restriction, and others by parochial obstruction, to such an extent that nothing short of a compact and powerful organization will effectually secure free and fair play to their natural and legitimate development. We have not before mentioned the telegraph cable proprietors and manufacturers; but it is not improbable they may see it to their advantage to join in such a combination for the common good. Many dangers threaten these industries, not the least of which is the confiscatory spirit which pervades the political atmosphere in these days, and which is the inspiring motive of the prohibitory conditions imposed upon electric lighting enterprise and the establishment of electric locomotion. But with or without the coöperation of any particular branch of electrical business, there are a sufficient number directly affected at the present moment to justify them in the formation of an Association of Electrical Engineers; and their interests are of sufficient magnitude to induce them, we are persuaded, to combine in some such manner as that we have indicated."

Chicago Electric Club.

The routine business of the meeting of the Chicago Electric club last Monday evening, the 7th, was very quickly disposed of under the management of Vice-president J. P. Barrett, and the members settled down to the enjoyment of the paper on "the effect of electric light induction on telephone wires" by B. E. Sunny, superintendent of the Chicago Telephone company, published in full in other columns.

The discussion of the paper was started by E. P. Warner, who first said that he coincided heartily with Mr. Sunny in his conclusions with reference to litigation between electric light and telephone men. He himself had had occasion to take some part in such "squabbles" and had found that in almost every case such litigation had ended in a compromise. Mr. Warner also agreed with Mr. Sunny in regard to placing an electric light wire above telephone wires, and added that if the electric light wire broke, it would open the circuit and render the wire comparatively harmless.

A. H. Brown asked Mr. Sunny how short a single length of electric light wire would have a perceptible inductive effect upon a telephone wire. Mr. Sunny replied that he thought it would depend somewhat upon the electromotive force. Many telephone wires in the city were crossed at right angles by electric light wires, but there was no noticeable induction. He thought the least distance would be 1,000 feet.

Chairman Barrett asked H. Ward Leonard what effect the incandescent electric light current had upon telephone wires.

Mr. Leonard said the effect was not noticeable. In Des Moines there was a very large exposure of telephone wires to the incandescent electric light wires of an Edison plant, but the effect was not noticeable at all there.

John Young inquired of Mr. Sunny what the inductive effects would be upon telephones on metallic circuits, to which Mr. Sunny made answer that he did not think they would be bothered at all. They had no metallic circuits, however, and he could not speak from experience.

Mr. Warner asked if Mr Sunny had ever noticed any difference in the different electric light systems in regard to induction. He had heard the claim made by certain dynamo manufacturers, that the rate of commutation in their particular dynamo was so very high as to reach a pitch inaudible to the ear, and that if there were induced currents, they would be inaudible. Mr. Sunny was unable to answer from experience, but stated that in the case of induction at Aurora, mentioned in his paper, the trouble was caused by a Brush dynamo, while at the Stock yards it was a Thomson-Houston dynamo. C. C. Haskins added that the trouble at Grenier's garden was occasioned by a United States plant. Chas. D. Shain explained that that machine was a 600 volt arc light dynamo.

C. J. Van Depoele gave an instance of trouble at Lima, O., where there is an electric street railway with overhead wires. For three or four days after the system was started there was no trouble, but one day there was a complaint, and investigation showed that a telephone wire had fallen against a pole carrying the electric street railway wire. He was of the opinion that more trouble was caused by the leakage of the current than by induction.

F. W. Cushing, superintendent of the Chicago Arc Light & Power company, asked Mr. Sunny if he had ever experienced any trouble from electric light wires when they were underground. Mr. Sunny replied that they had used a conduit in common with electric light wires, and absolutely there had been no induction on their telephone wires. Mr. Cushing thought this fact should be impressed upon the experts who had investigated the underground system of Chicago. Almost to a man they had said that electric light and telephone wires could not live together in the same conduit.

Chairman Barrett, city electrician of Chicago, said that the discussion of the evening had convinced him more strongly than ever that electric light wires should go underground, and now he was ready to assert that telephone wires should go there also.

J. W. Johnson inquired of Mr. Warner why there is no induction from electric light wires to telephone wires when they are placed underground. Mr. Warner, in response, said that the commonly accepted theory was that the lead or other shield of electric light wires acted as an anti-induction shield. "We find it is possible to run electric light and telephone wires in close proximity if they are well protected by grounded wires." He added that it took very little change of current to produce an induced current that makes an audible tone under proper conditions. He had even succeeded in producing an induced current in a telephone line from a storage battery, running incandescent lights.

Mr. Sunny was voted the hearty thanks of the club for his paper, and the meeting adjourned.

The next meeting will be held November 21st, when C. J. Van Depoele will read a paper on the operation of electric street cars.

Theory of Telephone Circuits.

By Dr. V. Wietlisbach in *Elektrotechnische Rundschau.*

Part I.

Telephoning over long distances constantly occupies the attention of telephone experts. The investigations which have been published in regard to this matter, in part apply only to special cases; in part they are, furthermore, entirely wrong. For that reason I shall briefly investigate the general case, as an addition to my previous essays, in which I dealt with two special cases, that is, the case of a cable free from induction, and that of an aerial iron circuit.

Every electrical circuit is determined by four differing and mutually independent factors—resistance, induction, electromotive force, and capacity. We will assume that the circuit is entirely homogeneous, so that each one of the factors above mentioned has the same value per kilometer over the entire line. We will assume that over the length of a kilometer, W is the resistance, L the induction, A electromotive force, and C capacity. We will indicate by V the electro-magnetic potential of all the electrical forces which are active at any given point. We will call J the strength of the current at this point, x shall be the distance of this point from the beginning of the line; then we shall have the following equations:

The Ohm law will give us, as the relation between the potential, resistance and induction, the following:

$$(1) \qquad -\frac{dV}{dx} = WJ + L\frac{dJ}{dt}$$

Electromotive force and capacity influence the strength of the current, as per the following equation:

$$(2) \qquad -\frac{dJ}{dx} = AV + C\frac{dV}{dt}$$

These are the two differential equations which determine the propagation of electricity in a wire. Their integration is very simple in the special case which we are investigating.

In telephoning we are constantly dealing with the transmission of sine or cosine waves. We shall again consider, as in the previous essays, the more general case of motion in the complex form $Ee^{imt} = (\cos nt + i \sin mt)$. The actual part of the result will then correspond to a cosine wave—the imaginary part to a sine wave. Furthermore, it is easy to see that the differential equations are also integrated in reference to x by an exponential function. Let us assume:

$$V = V_0 \cdot e^{imt} \cdot e^{px}$$
$$J = J_0 \cdot e^{imt} \cdot e^{px}$$

and introduce this into the above differential equations 1 and 2, and we shall have the following relations:

$$(1a) \qquad Vp = J(W + L\,im).$$
$$(2a) \qquad Jp = V(A + C\,im).$$

From these relations we can determine one of the two factors; that is, electro-magnetic potential or electromotive force, and current strength from the other. Furthermore, they determine the exponent p. If we eliminate V or J we shall have in each case:

$$(3) \qquad p^2 = [W + L\,im].[A + C\,im];$$
$$\text{also,} \quad p = \pm\sqrt{(W + L\,im).(A + C\,im)};$$

and the solution will take the form:

$$V = e^{imt}[V_1 e^{px} + V_2 e^{-px}].$$

The constants V_1 and V_2 must be determined from the conditions with which we began. If the circuit consists of a simple wire, whose length is l, and whose beginning is connected with a coil excited by the electromotive force Ee^{imt}, while the end is grounded, then the limiting equations for the beginning of the wire are:

$$x = O \qquad V_0 = e^{imt}[V_1 + V_2] = Ee^{imt}$$

and for its end:

$$x = l \qquad V_1 = e^{imt}[V_1 e^{pl} + V_2 e^{-pl}] = O.$$

From this we have for the constants the following value:

$$V_1 = \frac{-Ee^{-pl}}{e^{pl} - e^{-pl}}; \qquad V_2 = \frac{Ee^{pl}}{e^{pl} - e^{-pl}}.$$

We shall now obtain for the electro-magnetic potential at any point of the wire the formula:

$$V = Ee^{mt}\left[\frac{e^{p(l-x)} - e^{-p(l-x)}}{e^{pl} - e^{-pl}}\right]$$

and for the strength of the current on a unit basis:

$$(4) \qquad J = -\frac{1}{W + Lim} \cdot \frac{dV}{dx}$$
$$= \sqrt{\frac{A + Cim}{W + Lim}} \cdot E \cdot e^{mt} \cdot \frac{e^{p(l-x)} + e^{-p(l-x)}}{e^{pl} - e^{-pl}}.$$

We are especially interested in the strength of the current at the end of a circuit. We shall obtain this if we substitute for x above, the value l. We shall then have:

$$(4a) \qquad J = 2\sqrt{\frac{A + Cim}{W + Lim}} \cdot E \cdot \frac{e^{mt}}{e^{pl} - e^{-pl}}.$$

This simple formula has been obtained with the help of the complex factors. If we are desirous of separating the actual from the imaginary, and to represent the strength of the current in the usual form, as a sine vibration, we shall obtain very long, cumbersome formulas, which we refrain from adducing, as they are too difficult of comprehension for practical use. On the other hand, there is no difficulty in establishing the especial form of transmission in every special case, if the numerical values of the four factors, W, L, A, C, are known, if we employ our condensed method of calculating.

In applying the formula, we must take into consideration that resistance and induction are dependent on the number of vibrations, and it will be necessary to use the formulas for W and L, which appear on page 79 of the *Elektrotechnische Rundschau* of this year.

No accurate investigations in reference to capacity and electromotive force have been made. It is probable that these depend in all conductors—the air, perhaps, excepted—upon the rapidity of the oscillations, but these vibrations, which are relatively very small, are of no importance, when opposed to the great variations which are caused by temperature and moisture in the insulating materials which are, at present, in use.—(*To be Continued.*)

For Patent Office Reforms.

J. F. Morrison, president of the National Electric Light association, Walter C. Kerr, of Westinghouse, Church, Kerr & Co., F. J. Sprague, of the Sprague Electric Railway & Motor company, Frank Ridlon, of the Sun Electric Light company, and Arthur Steuart, general counsel, composing the legal committee of the Electric Light association, have issued the appended address to members of the association:

"The legal committee who have in charge the presentation to congress of the bill for reforms in the patent system, adopted at the August meeting of the association, request that the members of the association respond to the call made upon them for funds with which to conduct the canvass of the members of congress in the interest of this bill. The burden cast upon the

legal committee in prosecuting this bill before congress is a heavy one, involving the expenditure of a very great amount of both time and labor, but both time and labor will be expended in vain unless the members of the association hold up the hands of the committee and supply the 'sinews of war.' The committee have addressed all of the members of the association, requesting from them certain service in influencing the members of congress from their immediate districts and have asked that the members respond to this letter. It is very important that the committee should not be left in the dark, but should know exactly how much force they can count upon; for this purpose they request that the members write them at once whom of the members of congress they can expect to influence in favor of our bill.

"The committee have published the first of a series of pamphlets upon reforms in the patent office; this will be followed by others, one of which will contain articles by ex-commissioners of patents, and we hope to print in one of them some of the views of the judges of the United States courts, and still another by gentlemen familiar with the influence of our patent system upon our national growth and the development of our industries, especially the electrical. For this purpose some money is needed and we hope that the members of the association will appreciate the great importance of the subject intrusted to this committee and give it the aid required."

Personal Paragraphs.

Israel Lovett, superintendent of the Midland Electric company, Omaha, Neb., stopped in Chicago a few days last week on his way east.

Intelligence has been received of the death of John W. Swartz near Tehuantepec on the 23rd ult. At one time in Buffalo, N. Y., he simultaneously held the offices of superintendent of the fire alarm telegraph, and of the American district telegraph company and of chief operator in the Western Union Telegraph company. In 1881 he left that city and assumed a contract to build a telegraph line across the isthmus of Tehuantepec. Of late years he had held the office of superintendent of the Mexican Central & South American Telegraph company.

C. J. VanDepoele of the VanDepoele Electric Manufacturing company, recently returned from an extended eastern trip.

Henry C. Adams, secretary of the American Electric Manufacturing company of New York, was in Chicago Tuesday last on a flying business trip.

K. Sawai and Yoshichika Wada of Tokio, Japan, the former an electrician and the latter a civil engineer, were interested visitors at the meeting of the Chicago Electric club last Monday evening. Both speak English fluently. They are young men of education and are traveling through America, studying methods followed in this country. The former is interested more particularly in telephony and is striving to make an expert of himself. There are few telephone lines in Japan, said he to a WESTERN ELECTRICIAN representative, and they are on private lines. They have no exchanges but expect to ere long. Mr. Sawai has made a thorough and careful examination of the Chicago telephone exchange and will soon study the manufacture of telephones and telephonic apparatus.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	390
Central Union	44	45
Michigan	73	74
Great Southern	28	30
Colorado	18	20
Rocky Mountain Bell	40	45
Cumberland	80	85
Wisconsin	105	107
Bell of Mo.	157	160
Iowa Union	25	27
Missouri and Kansas	68	69

Independence, Mo., was lighted by electricity for the first time on the 28th ult.

Gas and Electricity.

Under this head the Chicago *Times* of the 6th inst. editorially says: "Those who are familiar with the rise and progress of the gas supply, not only here in Chicago but in other large cities, must conclude that, in the main, the system has been a failure. It has proved so in many essential particulars. In every instance where competition has been admitted, the result has been a combination of the interests and an increase in the price of gas, just the same as the union of the Baltimore & Ohio and the Western Union telegraph companies has largely increased the cost of sending messages between former competing points.

"It was said not long since, when there was a movement being made to secure the admission of a competing line into the city of New York: The public may think that additional and competing lines will give cheaper gas, but it will be found in the end that the public will have to support all the companies.

"One of the best known objections to the gas system is the fact that it offers unusual facilities for corrupt deals between the companies and municipal officials. The people of this city, while lacking positive and direct evidence of the facts, are certain beyond all doubt that for years there has been a deal between aldermen and the gas companies to the amount, probably, in twenty-five years, of a quarter of a million of dollars. Every cent of this amount has been collected from the consumers. The result is not merely direct robbery, but it also includes a deep official corruption whose influence has spread in every direction among the municipal persons directly interested.

"The alderman who was induced to take a bribe for giving the gas company a favorable contract very naturally did not hesitate to accept bribes in other directions. In fine, the gas corruption has spread until it affected, or infected, dealings with all classes of corporations and all great enterprises in which the city was called on for permissive action.

"On account of its tendency to trust combinations, its disposition to corrupt officials, its incessant interference with the condition of the streets, and for numerous other reasons, it is desirable that the present gas system should be supplanted by something which lacks all these objections. If illumination by gas be thought to be the better plan, then it probably should be the work of the municipal corporation, as is now the supply of water by the cities and the carrying of the mails by the federal government.

"There are a good many excellent reasons for the continuation of gas-lighting besides those involved in mere illumination. By a cheap production, its use as a fuel would be largely increased. On this point a Philadelphia writer has expressed some valuable opinions. He says that gas is coming more and more in use as a means of cooking and driving machinery. There is probably no department of household expenses in which there is uniformly more waste than in that of the fuel supply. In our best ranges the loss of unutilized heat is enormous, even where the coal is fully consumed. Much is wasted, owing to the incomplete combustion of coal, and the same is true of heaters. Kindling wood costs a large sum, and there is considerable expense attending the getting of coal to the house and the removal of the ashes, to say nothing of the expense of the labor involved in caring for the heaters and the ranges.

"It only requires that gas should be supplied at a reasonable cost to remove all these defects and to secure for the people an immense improvement at a material reduction of the present cost.

"At the same time it should not be overlooked that gas, even at its best, is far in the rear of electricity for all the principal uses of the former. It is very much inferior as an illuminant, and, from a sanitary point of view, is deleterious, which can not be charged to the use of electricity. Houses can be heated and lighted, cooking can be done, and machinery driven by electricity, and in all instances with a more efficient result than when gas is employed for the same purposes.

"It would be an almost infinite improvement over the present gas system if the city should take charge of its manufacture and supply; and it would be a still greater advance if, for gas, the city should substitute electricity."

Electricity, Steam, Cable, or Horse Power?

Last summer, C. O. Bean, city engineer of Tacoma, W. T., made a thorough examination of the various street railway systems in use in this country in the interests of northwestern capitalists, figuring upon the best motive power, all things considered, for a street railway in Butte, Mon. Substantially all of Mr. Bean's report is appended. It is exhaustive and, as a whole, is an interesting and valuable paper:

"In the first place, there is a widespread interest manifested in new improvements and appliances. There probably has never been a time in the history of street railways when there was so much careful investigation or so much keen interest manifested on the part of owners and officers of roads as at present. The various systems are being critically examined by numerous experts and railway managers. In some instances, where the distance to be traveled is not great, the aldermen of a city have gone in a body to examine certain systems before granting franchises. Letters of inquiry are almost without number. I met several parties, whose errands were the same as mine, and wherever I went I heard of others who had been there before me.

"I first examined the horse car system of Portland, Oregon; there I found them complaining of six and seven per cent. grades, and eagerly watching the development of the reported cheap cable systems and electric systems. They seemed eager to do away with horses. The expense of feed, blacksmithing and general repairs is not small.

"The next examined was the so-called noiseless exhaust steam motors used in Minneapolis. There the grades were very light and the traffic quite heavy. People in the suburbs were well pleased with it, because of it being so much more rapid than the horse car; but in the city proper, and particularly in the business portions, there is decidedly strong opposition to its use. The opposition is so strong that the company talk of putting in a cable road. Too many teams are frightened by it. The exhaust is noiseless only after starting, and on comparatively level ground. At starting, and on heavy grades, the noise from the exhaust is very objectionable.

"The next place visited was Chicago, where a short line, a few hundred feet in length, of the Rasmussen cable, is on exhibition. The Rasmussen system is far from perfected, and is run on far too small a scale to enable one to judge of what it will do on a large scale. * * * The builders now estimate the cost at not less than thirty thousand dollars per mile, exclusive o track. I also examined the California system of cable used on State street in Chicago. It is working successfully. It is useless, however, to attempt its operation except in places where the traffic is very heavy, since its cost is about one hundred thousand dollars per mile. In such places as St. Paul, Chicago, St. Louis, Kansas City and San Francisco, where the traffic is heavy, it is used with marked success and satisfaction.

"In Detroit, Mich., I carefully examined the Van Depoele Electric railway on what is called the Dix road. They have a poorly ballasted road-bed, and their motors are not of ther ecently more approved pattern. They haul their trains, however, without trouble, and the road is giving as good satisfaction as could be expected under the circumstances.

"The next examined was the Fisher system of electric railway in Detroit. I found this system in an experimental state. On this road the conductor is in a conduit between the rails. A conduit of this type can never be used with safety and success in the streets of a city, though it will do in the country.

"In Windsor, Ontario, the road is a common wooden stringer with a strap iron on the top. The road is working successfully. The owners are so well pleased that they have ordered T rail for their road.

"The Van Depoele people said nothing to me about the Port Huron road, in consequence of which my suspicions were awakened, and I concluded to go there. A large part of this road has T rail of only sixteen pounds weight to the yard. I met the secretary of the Port Huron Electric Railway company from whom I learned that his company at first experienced considerable trouble through the fault of the man sent to fit up the cars. At one time they were considerably disgusted and thought of discarding the electric motors entirely. Now they are well pleased. They claim their expenses are one-third less than with horse, and far more satisfactory. On reaching the suburbs they run their cars from ten to twenty miles per hour without trouble. I was a passenger on one trip when all of fifteen miles per hour was the rate of speed.

"I next visited Pittsburg, Penn, where several electric railway companies had roads on paper. I found them preparing to use electric motors and in one instance on grades as steep as fourteen per cent. I could not well stay several weeks in Pittsburg waiting for roads to be built, so went to Scranton, Penn. The road in Appleton Wis, and one in Scranton, Penn., are two roads to which nearly all, if not all, electric railway companies, as well as electricians, point with unconcealed and becoming pride. They have good road-beds, beautiful cars, good motors, and are well managed. Mr. Sturges, the president of the Scranton company, told me that before adopting the electric system he had seen the various electric systems in Europe and had carefully examined the systems in America. He claims it is cheaper and far more satisfactory than horse power. Before adopting the system the directors were almost unanimously opposed to the use of electricity, but yielded to Mr. Sturges. They are now unanimous in its favor. The directors are so thoroughly convinced of the practicability of the system that they were building when I was there, a generating plant, that was estimated to cost $25,000. I met a gentleman who had personally examined the Appleton road, not once alone, but several times during both summer and winter weather. Its success has probably been more marked than that of any other electric road in the world. In Appleton a snow plow was attached to the car when necessary and the motor cleared the snow from the track even on the worst grades. It exceeded the most sanguine expectations of its warmest advocates. Not until I had been in Scranton did I feel at all like forming a positive opinion of the practicability of the application of the electric motors to street cars. The visit to Scranton decided me in favor of the motor.

"Still there were two questions left, viz: Is there a better system than the Van Depoele? Will the motor answer for our heavy grades?

"I next went to Baltimore to see the Daft system at work. I can say that I am still almost surprised at what I saw there. A very light motor car, a regular rattle trap of a thing in fact, carried the motor. The wheels of the motor car were out of true and pounded on the rail so much as to render it exceedingly difficult for me to ride on the motor car even when hanging on with both hands. Yet this little motor car, loaded only with the motor and its attendant, hauled a full load of passengers easily over a road noted for sharp curves and heavy grades. A careful examination of the electric road in Baltimore convinced me that far steeper grades can be successfully ascended with the electric motor than have heretofore been attempted or than can be overcome by any other system than the cable.

"I next visited the Baltimore Locomotive works in Philadelphia, concerning steam motors, and was the more convinced that they will not answer for heavy grades, within city limits.

"I next called at the offices in New York of all the principal electric railway companies. Unfortunately none but the Daft had at that time any lines equipped, though it was expected to soon begin equipping important lines with the Sprague system, the Julien, and the Bently-Knight. I examined their several stationary motors where they were convenient, and carefully inspected drawings and plans of the various systems.

"My next visit was to Lima, Ohio, on July 4th, where during the celebration of the 4th of July it was proposed to start four new electric cars on a new track with a new generator, new operators and new conductors. The cars were just from the shops with bearings all new and whee's rusty and rough. The rails had been laid some time and were consequently covered with rust, mud and sand. The streets were thronged with a large number of people to whom an electric car was one of the wonders of the age. The number of passengers that crowded upon the cars was astonishing. The cars commenced running at 7 a. m., and were still running at midnight when I left. The conductor told me that he had over eighty passengers on a car at one time repeatedly during the day and evening. This was on what is called twelve-feet cars. The owner of this road is one of the wealthiest men in that part of the state. He told me that after buying the street railway he had personally inspected all the street railway systems he could hear of, including every electric railway then in use. He decided to use the Van Depoele system. Without waiting to experiment he equipped four cars and erected one of the best and most complete generating plants in America. He is thoroughly pleased with the system he adopted.

"Having learned the causes of difficulties that have been met on some few of the electric lines when first put in operation, I concluded to spend a few days in the shops where motors are made and see for myself all the details of construction. I found the time profitably spent and have no doubt that the experience thus gained will soon be of use to others.

"I next examined the cable roads of St. Louis and then of Kansas City. They are all of the California type. In Kansas City I found the Henry system of electric railway. Here again are six per cent. grades. The electric motor was doing its work well. The makers have not yet properly proportioned the various parts of their apparatus, and are yet really experimenting, remodeling and improving.

"I next examined the Daft electric motor in Los Angeles. It is still doing good work and is giving general satisfaction. The difficulties here are not so great as at Baltimore and hence the success of the Los Angeles road is not so surprising.

"The next examined were the steam and cable roads of San Francisco and Oakland.

"I have omitted stating that in Brooklyn there is on trial a new kind of cable. It is composed of two cables about three-fourths of an inch apart with short bars across about every eight to twelve inches like a rope ladder. Thus far the builders have attempted to run on straight lines only. The system is in an experimental state as yet. It will cost more than the Rasmussen system.

"You will understand from the foregoing that I have examined the steam motor systems, three cable systems, four electric systems in use and others on paper, besides horse car lines too numerous to mention.

"I have attempted, at least, to judge without prejudice, of the merits of the various systems, and in advising you which system to adopt, have taken into consideration the peculiar conditions under which a system of street railway will have to be operated in Butte.

THE CABLE SYSTEM.

"You can not safely estimate the first cost of construction at less than $100,000 per mile. The cost of operating by cable system in your case would be very great relatively to other systems. In the first place, from 70 to 80 per cent. of the entire power is spent in running the cable when not loaded. Track repairs are more expensive than on any other system and there is need of more fuel and oil. It is, no doubt, the very best system for large cities, but can not pay in Butte.

THE STEAM MOTOR.

"Notwithstanding all that is claimed for it, it is not a safe motor to use on the streets of any city. It is admirably adapted to long suburban lines where traffic is comparatively heavy or on lines connecting cities not far apart. Such motors as you would need, would cost, exclusive of freight, about $4,000 each. You could not use them on grades heavier than seven per cent. Besides the expense of fuel, you would be obliged to employ a fireman and engineer on each motor. When passing through the streets of a city, the engineer should be at his post all the time. The steam motors frighten horses worse than any other street car motor; but leaving that fact out of consideration it is expensive.

HORSE CAR.

"Your grades are such that, if you use horses, very light and small cars will be necessary, and your speed will be so slow, that more cars will be needed than is generally required on such short lines. On your two lower lines you could use two horses per car and get along in the old-time way, but on the Walkerville line four horses to the car would be necessary. As a rule, horses are driven on horse cars but five hours per day, there being what you miners would call three shifts. One of the chief difficulties with the operation of your lines by horse power is the heavy traffic at certain hours of the day when the miners are going to and returning from the works. From what I could see of Butte, I judge there will be quite a rush at certain hours when, if horse cars were used, several would be required at one time. The horse car system is undoubtedly the cheapest in the first instance.

ELECTRIC MOTOR.

"As they are operated in Appleton, Wis., Scranton, Pa., Baltimore, Md., and several other places, they are undoubtedly successful. They are safe, economical, powerful. They show their merits to an appreciable extent when from any cause sixty or eighty passengers crowd upon one car. Wherever they have taken the place of horse cars, traffic has almost immediately increased by quite a large percentage. Many persons ride on an electric car for the novelty of the thing and advise their friends to do the same, and invite their visitors from abroad to ride. In Scranton, many of the well-to-do class of people ride for pastime in the evening to the outskirts of the city and return. Motors are now successfully running on eight per cent. grades and carrying such large loads and are able to pull so much more after them, that I am convinced that they will ascend much steeper grades. I have seen enough to convince me that they may be successfully operated on as high as fourteeen per cent. grades, by keeping the rail clean. In all probability it would be necessary to use a little sand when ascending and an improved brake when descending. In bad weather, it might even be necessary to assist them on fourteen per cent. grades with a team of horses. Even then they would be cheaper than any other system. On your road the electric car would have a great advantage over horse cars in one particular. Such a car as you will use will carry when it is necessary over eighty passengers and travel at a much higher speed than the horse cars. It is my opinion that one such car will in Butte easily do as much work as two at least, if not three, such horse cars as you would use. One motor will take the place of at least fifteen horses in your line and will run twenty-four hours every day if you wish it.

"I am well aware that very few engineers agree with me in regard to the capability of the electric, or any other tractive motor to ascend a fourteen per cent. grade. Only two things need to be taken into consideration, power and adhesion of wheel to rail. As for the power of the motor we all know that for all practicable purposes now under consideration we are not limited. I know that cars have been run on grades as steep as eighteen per cent. I have seen cable cars stopped on eighteen per cent. grades, freed from the cable and lowered by the use of the brakes to the foot of the grade. I have for a long time been convinced that the electric motor would ascend a fourteen per cent. grade, but was afraid of the descent. Serious accidents have happened to horses descending as light a grade as seven per cent. They have been known to slide to the bottom of the grade with the wheels set. There is now made a brake that is absolutely safe on at least as high as eighteen per cent. grades. It has been thoroughly tested and is beyond a doubt a complete success.

"As to the choice of motors, I suggest the following considerations: They are all reaching a greatly improved state. The Daft, the Fisher, the Sprague, the Henry, are all good, but at pres-

ent I have more confidence in the Van Depoele, for the reason that it is in use on more roads than all others combined, thus enabling Van Depoele to study the motor under a great variety of conditions, and to learn wherein improvements can be made. I feel further influenced by the fact that several of the most careful railway managers, after carefully examining the other motors, chose the Van Depoele. For a continual successful use of the electric motor it is absolutely necessary that it should be close under the eye of the operator. This is a fact that Van Depoele alone seems to fully appreciate. The brush on the motor should be free from dust. The foregoing will probably be sufficient for the following advice:

"On your lines I advise the use of two electric cars for the present. The cars should be sixteen feet long. The cars are made by the Pullman Palace Car company. The two motors should each be twenty-five horse power. These two cars will surely do all the work on your two lower lines and I am confident will do the work on the Walkerville line. They will travel at the rate of three miles per hour on fourteen per cent. grades and faster, of course, as the grade decreases. On the light grades they will run twelve or fifteen miles per hour. The pay of operators is the same as that of a horse-car driver. An intelligent young man, or even boy can learn to run one in an hour. The cars, when necessary, will carry, by crowding, over eighty passengers each and will run when thus loaded at the rate of speed above mentioned. It is my opinion that two such cars will do the work of at least five such horse cars as could be used on your road. If I remember aright, about twenty-five hacks are employed in carrying passengers in Butte City; you need have no fear concerning the profits of the street railway.

"The following are approximate estimates of the cost of construction, exclusive of tracks, of the two systems, electric and horse power:

ELECTRIC SYSTEM.

Two cars, 16 feet, at $1,300	$2 600
Two motors, 25 horse power each, at $2,200	4,400
Copper wire	875
Insulators, etc	1,000
Two sets gearings and attachments	400
One generator	4,200
Engine and boiler	4,500
	$17,975

Add cost of one story building, about 25 to 30 feet by 100 feet for cars and machinery.

HORSE CARS.

Five cars at $850	$4,250
Thirty-four horses at $150 each	5,100
	$9,350

Add cost of building 60x100, two stories high.

"By the electric system your daily expense would be made up of the following items: Interest on first cost, depreciation of plant, about two tons of coal, oils, one engineer, two car men, and a little for repairs and insurance.

"By the horse system your daily expense would be made up of interest, depreciation, feed, repairs, two stable men, five car men, veterinary's bills, and insurance.

"The following items, in case of electric motors, are somewhat larger than with the horse system: Interest, fuel, and possibly insurance In case of the horse system, the following items exceed those of the kind in the electric system: Depreciation — horses give out rapidly — feed, repairs, and wages of men.

"I consider the cable system far too expensive for your use, and the steam motor impracticable on account of grades, noise, cost and expense of operating.

"The estimate is for factory prices, exclusive of freight. The first cost of the electric system is much higher than the horse-car system, but, allowing liberally for the operating, expenses in favor of horses, still the profits per day with the electric motor are from ten to thirty per cent. more than by horse car. This has been proved in Port Huron, Windsor, Scranton, Baltimore and other places.

"One great advantage that in the near future the electric system will have over other systems, is the furnishing of motor power along the route for running many kinds of machinery. By increasing the size of the generating plant, enough power can be sold to pay all operating expenses. In a place like Butte, where fuel is scarce, it could be developed to quite a large scale. In New York electric power is now furnished for driving nearly all kinds of machinery. I saw one machine shop operated by a little motor that occupied not more than four cubic feet of space. The owner thus dispensed with engine and boiler and rooms for the same, coal and coal shed, and engineer. He was not troubled with smoke, steam or dirt, and saved quite a large water rent. Elevators, spice mills, dentists' tools, lathes, sewing machines, paint mills, etc., etc., are operated in the same way. In New York there are several companies that make an exclusive business of furnishing electric current for motive power. I mention these facts simply to show what, in the future, can be done in Butte, though I do not advise you to enter the business on too large a scale at present. I advise the purchase of only two cars and two motors, for the reason that in the near future motors will be far cheaper than they are now. One manufacturer told me that he thought that in six months motors can be had for one-half their present cost. Experience has proved that the cars commonly made are not the thing for the electric motor. Pullman is now making a much stronger and better car expressly for electric motors. Again, when the cars are made by Pullman, Van Depoele fits the motors and all attachments to the car before shipping, thus saving the purchaser a heavy expense and much annoyance.

"To insure the securing of the right kind of machinery and apparatus throughout, I should advise you to order motors, cars, engine, boiler, and wire through Van Depoele. It is the surest way to secure good work and to place upon Van Depoele full responsibility for the successful performance of all parts pertaining to the system.

"If you adopt the horse system, either Brill works of Philadelphia, or the Pullman company of Chicago, can furnish you good cars. There is not much difference in cost for like kinds. After you decide what system to adopt, if you will write or telegraph me what you wish to do, I will write the manufacturers, informing them as to just what you want, or, if it suits you better, you can do so yourself."

A French Automatic Fire Alarm.

A description of a novel automatic fire alarm is given by Edme Genglaire in *Electricité*. He writes: It is known that the most simple fire alarms in houses consists of a V tube closed at one extremity and terminated at the other by a tight and compact balloon. A gaseous mass is in contact with a small quantity of mercury. An abnormal heat, that is to say exceeding 40° C., causes an expansion in the gas, and this expansion has the effect of bringing the mercury into communication with the two poles of a battery and consequently of establishing a current. An electric chime completes the apparatus in this rudimentary state. The same arrangement can be utilized for announcing publicly the commencement of a fire.

The wires of a battery put in action by the expansion of gas connect with an electro-magnet which attracts the key of a hydrogen generator. The condensation of gas in platinum sponge lights a small oil lamp, and an explosive, previously arranged upon the wick, takes fire at the same time that the glass of a case held vertically describes an arc of a circle on the outside for allowing the explosive to leave freely, which gives the alarm by its detonation at the time that the lamp, extinguished by the expansion of the air made by the detonation, immediately relights itself, showing the public the danger of fire.

The whole apparatus is inclosed in a case lodged in the masonry or upon a support placed along the wall at so great a height as to protect it from wanton injury. A hydrogen lamp is of very easy construction. The platinum sponge alone entails a slight expense.

The tube indicator of the beginning of the fire is placed in the house and the electric wires are attached to a signal apparatus in the vestibule; several tubes can be attached to the same apparatus, and an examination of the level of the mercury in each reveals the position of the point threatened in the habitation. This instrument does not necessitate any great maintenance, and the only care to be taken will be having a battery of settled constancy, and replacing from time to time the sulphuric acid of the hydrogen generator.

CORRESPONDENCE.

Eastern Notes.

NEW YORK, Nov. 5.—The Electrical Accumulator company, of New York, are rapidly disposing of franchises covering exclusive territory for the sale of their apparatus. They have recently disposed of such franchises as follows: To C. F. Annett, general manager of the Rocky Mountain Bell Telephone company, the territories of Utah, Wyoming and Montana; to the Electrical Accumulator & Lighting company, Detroit, the state of Michigan. This company was organized with a capital of $100,000, and the business is being vigorously developed under the direction of the following officers, all of whom are well known in the telephone field: Jas. McMillan, president; Wm. A. Jackson, vice-president; W. K. Anderson, treasurer; W. C. McMillan, secretary; Geo. E. Fisher, general manager. The business offices of the company are at 91 Griswold street, Detroit, where an accumulator plant, in connection with power and incandescent lighting, is on exhibition. Another franchise has been granted to the Connecticut Isolated Accumulator company, for the state of Connecticut. The headquarters of the company are at Birmingham, and they have already placed a large plant for incandescent lighting in the mills of the Shelton Brass Hardware company.

It is expected that some interesting facts and figures will be made public by the assembly investigation of affairs of the telephone companies in and about New York. Summons have been served on the officers of the Staten Island Telephone company, the Westchester telephone company, the Hudson River Telephone company, and others, who are commanded to appear before the committee to be examined under oath, bringing with them all books of original entry journals, ledgers, documents, etc., or sworn copies thereof, from the time of the organization of their companies. This is the same committee who have been taking testimony in the territory of the Bell Telephone company, of Buffalo, the results of which were fully reported recently in the columns of the WESTERN ELECTRICIAN. The details of these investigations throughout the state are to be embodied in a report which the committee will hand to the legislature on the first Tuesday in January next, with recommendations concerning the necessary legislation which they may consider desirable.

Much has been published recently about talking machines and phonograph possibilities. That Mr. Edison is not the only inventor working in this field is certain, as at least two factories in New York are now working on instruments for registering the human voice in such way that it can be repeated at will. It is promised that by the first of next year phonographs or graphophones will be in practical and commercial use.

Most of the Bultimore & Ohio offices have been closed, and rates have been fixed by the Western Union and Postal companies at prices which it is said will be permanent. The Postal people feel happy over the situation, as their business is largely increased on account of their advertising their lines as the only "opposition," and on account of their rates to most points being five cents less than the Western Union tariff.

Theo. Mace, of the Vitrite & Luminoid company, states that the affairs of the company have been placed in his hands as receiver simply for the purpose of a reorganization; that the business is in satisfactory shape and will soon be resumed under a new name.

The New York *Graphic*, which has been in the market for some time, has been purchased by a syndicate of New York and Philadelphia capitalists, the negotiations for the purchasers being conducted by Edwards H. Goff. It is announced that Mr. Goff will be president of the new organization.

The American Electric Manufacturing company have declared a dividend of 1½ per cent.

for the quarter ending October 1st, payable on and after December 5, 1887, to stockholders of record November 25th.

Hazazer & Stanley are making a very handsome annunciator in old oak, with push buttons in gold and ivory, for electric calls for the new club house of the New York Electric club. It is promised by the managers of the club that the new house will be opened with appropriate ceremonies about the 24th inst.

A telegram from Halifax, November 1st, states that the circuit of the short cable of the United States Direct Cable company has been completed between Halifax and Rye Beach, N. H., and that the cable was laid around Brown's Bank instead of over it, in order to avoid any interference from fishermen.

Israel Lovett, Superintendent of the Midland Electric company, of Omaha, Neb., is visiting friends in New York and Boston and looking for electrical novelties for his company. A.

Cincinnati Chat.

CINCINNATI, Nov. 5.—Mr. Walters, of the Bottled Lightning Manufacturing company, has returned recently from an extended trip to New York and other eastern cities, in the interest of the battery manufactured by his company. The battery is of the Leclanche disque pattern, the only noticeable difference being in the shape and material that the jars are made of. The company are meeting with excellent success in placing their goods on the market. Mr. Walters left this week for an extended western trip.

While on the subject of batteries, reference might be made to an invention of another Cincinnati electrician, that is, the gelatine battery, of which H. B. Cox is the patentee. This is a dead shot at all open circuit batteries where a liquid is used, as the excitant is a semi-solid, composed of a gelatinous mass that retains moisture enough for all purposes, and still has no liquid to spill or run over. The bother of removing and cleaning zinc is entirely overcome in this battery, as one of the main features of its construction is to keep the zinc thoroughly amalgamated and to prevent anything adhering to it. Batteries that have been tested on very hard work for months have had the zinc removed and found to be perfectly clean, and only by careful weighing could any decrease in the zinc be detected. The carbon is of a U or horseshoe shape. With a medium electromotive force, a high quantity current, and an extremely low internal resistance, it can lay claim to three excellent points for an open circuit battery. Being sealed makes it portable and always ready for use, and the cleanliness will assure it a success, especially for car and telephone service.

E. V. Cherry, of the Standard Electrical works, attended the American Street Railway convention at Philadelphia. Mr. Cherry is a wideawake man on electrical apparatus, and takes great interest in anything that will advance that branch of the business, and, from reports, it seems that in future the street railway will be run exclusively on that plan.

Granville T. Woods, electrician of the Woods Electric company, has taken out patents covering an electric brake which the company are very confident will prove a success. They expect a good business with this and the telephone system and apparatus, also invented by Mr. Woods. C.

Indianapolis Items.

INDIANAPOLIS, Nov. 6.—The Howard Watch & Clock company of Boston, through its agent here, have just completed putting the electric clocks in the state house. There are seventeen clocks, located in different rooms of the building, controlled by the master clock in the basement, which is one of the finest pieces of work of the kind ever put up. Tests made so far show the clocks vary fifteen seconds a week. Mr Walk, the agent, says this variation will be overcome, so that the clocks will keep accurate time as guaranteed. The price paid was $1,525.

The B. & O. telegraph office at this place has been closed and the wires and instruments transferred to the Western Union office. The force has been provided for; Mr. Lemon, manager, has gone to the Postal as chief operator; the former manager of the B. & O. board of trade office has taken charge of the Postal office at another place; the other operators are with Western Union.

The natural gas excitement runs high here. Three companies are already in the field. Two companies have accepted ordinance rates as passed by the city council. The other company, composed of leading coal dealers and stockholders of the artificial gas company, say they will pipe gas to the city limits and wait till citizens want it bad enough to pay higher prices for it. The latest competitor is the Consumers' Gas trust, organized by the citizens; capital stock $500,000, divided into $25 shares. Manufacturers, merchants and citizens generally are taking great interest in booming affairs, as it is intended to furnish gas, at actual cost, to consumers of all kinds. If it proves successful there is no better point in United States for manufacturers. M.

Detroit's Budget.

DETROIT, November 5.—There has been considerable talk of late as to the advisability of the city establishing its own electric light plant, and thus solving the interminable public-lighting question. It has been stated that, if this plan were adopted, the cost for lighting would not exceed $35,000 per annum; that less than $200-000 would purchase the existing towers and all necessary apparatus, and put the system in operation within one year. Looking to this end, a resolution was introduced at the last council meeting, "that a committee of five, including the mayor, be appointed to investigate and report upon the practicability of the city owning and operating its own electric light plant, which committee shall have full power to make such expenditure as is necessary to ascertain and examine into all facts pertaining to such plan of public lighting." Although the resolution was tabled, several aldermen expressed themselves in sympathy with the plan, and it is likely more will be heard of it. The public lighting committee in a report unfavorable to the adoption of any portion of the gas companies' proposition to light the city for a period with gas and naphtha, and later on with electricity, say that public opinion is strongly in favor of an investigation as to the practicability and feasibility of the City owning its own plant. This change has been brought about by the attitude of the press of Chicago and Detroit.

The controller has again been authorized to advertise for a period of five days, for bids for lighting the city with electricity, practically as now lighted, for a term of one, two and three years from June 30, 1887, also to advertise for a term of two years from June 30, 1888.

The recently organized Electric Accumulator and Lighting Co. has opened an office on Griswold street, where an extensive plant is on exhibition. The company report considerable demand for the storage battery, and has already several large orders entered. The Newberry & McMillan building is to be equipped with a plant for 200 lights; Metcalf Bro's. will increase their Edison plant to a capacity of 500 lights by taking 100 cells of the 15 A type. A 500-light accumulator plant at Petoskey, Mich., is also being arranged for. The company purpose entering largely into the household lighting field. Among other residences, the system is being introduced into those of H. B. Ledyard, W. K. Muir, Hugh McMillan, Mrs Newberry and James McMillan.

An effort is being made to interest Detroit capital in the construction of an electric railway from the northern terminus of the Highland Park road to Norris, eleven miles from Detroit. The road would run from Norris to the Mack road, and there connect with the Grosse Pointe road, now nearing completion. C.

From the Pacific Slope.

SAN FRANCISCO, Oct. 26.—A little over a year ago the Thomson-Houston company and the Pacific Coast Electric Construction company occupied the field at Santa Rosa in opposition. The competition was lively, the Pacific company investing, it is said, over $15,000 in station and motive power, their whole installation representing an investment of between $25,000 and $30,000. The Thomson-Houston plant was sold to the gas company last spring, and since then the competition has been particularly sharp. The service of the Construction company at last became unsatisfactory and, as reported, but about twenty consumers remained when the Thomson-Houston company's offer of $1,500 for poles and wires was accepted, the former agreeing to remove dynamos and all appliances from the city and give the Thomson-Houston company the field. The prices of service had, of course, been very low, $6 and $8 per month per lamp being the approximate prices. The latter company immediately announced increased prices for services, averaging $10 and $12 per month per lamp, which, to a person who has had any experience in the business upon this coast, will not seem exorbitant, and good proof of this is seen in the fact that the Thomson-Houston company has now more orders for lamps than it can fill with its present dynamo capacity. C.

Meridian, Miss., Mention.

MERIDIAN, MISS., Nov. 4.—It was some three years ago when the telephone was introduced in Meridian as a business enterprise. The company began with twenty-five subscribers, the number only slowly increasing, the service being insufficient and on a crude plan. As the service was improved, the demand for instruments began to increase.

The Great Southern Telegraph & Telephone company still operate the service. A. M. Johnson is the present manager, a position he has filled for the past eighteen months. Within the last year the business of the company has increased more rapidly than that of any other place in the state, the number of instruments now in use being ninety-five, with the prospect in view of the facilities of the office being increased to meet the demand.

Since the company moved into its new quarters, at the corner of Second street and Twenty-third avenue, the Western Electric company's latest improved switch board has been in use. The switch board is thoroughly protected with the latest improved lightning arrester.

The company is preparing to replace the present poles with chestnut poles, forty-five feet high, which will get the wires above the houses. A line to Marion is also contemplated. A.

THE ELECTRIC LIGHT.

The town of Greenville, Mich., is to be lighted by electricity.

Burrton, Kan., has decided to put in the electric light.

It is said that Paris, France, is to have 200,000 electric lights planted in its streets.

The city authorities of Florence, Italy, have ordered that all theaters be supplied with electric lights within one year. Similar orders have been issued by the authorities of Genoa, Bologna, and Padua.

Articles of incorporation of the Edison Illuminating company, of Monmouth, Ill., signed by N. A. Scott, William B. Smith and Henry H. Pattee, all residents of that city, have been filed. The company proposes to establish a plant, with electric light, heat and power facilities within thirty days.

The board of directors of the Sterling, Kan., Electric Light & Power company have accepted the proposition of the Archer Electric Manufacturing company of Wichita, and the work of building, and putting up the poles and wires will be begun at once. Everything is to be ready within thirty days, at which time there will be three hundred lights in operation.

THE ELECTRIC MOTOR.

For newspaper offices the electric motor is steadily advancing in favor as the motive power. The Lowell, Mass., *Daily News* and *Daily Courier*; the Lawrence, Mass., American and the Elgin, Ill., *News*, are among the papers not already noted in these columns which have availed themselves of this most convenient, clean, safe, economical and steady power.

The LaSalle avenue tunnel in Chicago is to be ventilated by a big fan which will be operated

by an electric motor. This tunnel belongs to the city but is now rented to a street railway company that has a cable system on the north side of the river and passes that barrier to the south side by going through the tunnel.

Wheeling, W. Va., is to have an electric street railway.

On the Brussels electric tramway matters are not yet perfectly satisfactory, the motors still giving some trouble, says a correspondent of *Industries*. Burnt up armatures and other causes of break-down continue to occur from time to time, while the arrangement of the regulating and brake handles is in practical working not found to be sufficiently convenient. When it is necessary to apply the brake, the driver must first switch the current off by means of the regulating switch, and afterwards he can put the brake on; but there is the danger that he may forget to switch off before putting the brake on, and even if he performs both operations in their proper order, there is a slight loss of time which in cases of emergency may be of some importance. To provide a remedy M. Moreau has worked out an arrangement by which the action of switching the current off is performed automatically from the brake spindle, so that the driver has only to attend to the latter. On the brake spindle is a ratchet wheel actuating a couple of pawls, by which a special switch is controlled.

Leonard & Izard of Chicago are making figures upon an interesting job involving the transmission of 60 horse power from a water power in Colorado to a mill at a distance of two and one-half miles. Coal costs $18 a ton and every piece of machinery or article used at the mill has to be carried there on the backs of mules.

THE TELEPHONE.

Three underground cables each 1,900 feet in length recently laid in Cleveland have been tested and found to work perfectly.

Phœnix, Ariz., expects to have a telephone line, electric light, street railway and a skating rink.

A fortnight ago the Chicago Telephone company lost 500 wires by a small fire in the upper story of a building. Fortunately the fire occurred Saturday night and gave the linemen time to get the wires in order again before the rush of Monday began.

THE TELEGRAPH.

November 3d a certificate was filed in the county clerk's office, at New York, setting forth that the Western Union Telegraph company has increased its capital $5,000,000. This makes the total stock $86,200,000.

The Postal Telegraph company, now that the Baltimore & Ohio has withdrawn from the opposition field, is redoubling every energy in pushing forward its facilities. There are eight new wires in course of erection through New York state, to accommodate the local business, which has been greatly augmented since the recent consolidation. Four new wires from Indianapolis to Chicago are almost completed, thus establishing another route between New York and Chicago.

A Baltimore dispatch of the 3rd inst says; "Vice-president Spencer, of the Baltimore & Ohio Railroad company, cleared up a doubt to-day that has existed with regard to the manner in which, and by whom, the telegraph business of the railroad would be handled. He informs a reporter that the company retained absolute ownership and possession of a sufficient number of wires along the line of the road and between Philadelphia and New York with which to handle all business pertaining to the road. The company will continue to employ its own operators for this purpose, over whom the Western Union will have no jurisdiction. The Western Union will also handle any Baltimore & Ohio railroad business that may be offered."

Miscellaneous Notes.

November 9th a joint meeting of the American Institute of Electrical Engineers and the New York Electrical Society was held in the manager's room in the exhibition hall of the institute. Charles Cuttriss, electrician of the Commercial Cable company, read a paper on "Recent improvements in apparatus for ocean telegraphy."

Rapid transit in Chicago consists of something more than rumor as the recent incorporation of the following companies shows: Chicago Western Elevated Railway company; capital stock, $20,000,000; for the construction and operation of an elevated railroad from a point on Michigan avenue, between South Water street and Monroe, running west to the west line of Cook county; incorporators, James Felch, George S. Calkins and Ezra L. Brainerd; and the Chicago Rapid Transit company; capital stock, $1,500,000; to construct and operate elevate railroads within and without the city of Chicago and its suburbs; incorporators, George C. Buell, Edward S. Richards and James E. Beeks.

Business Mention.

Schmidt, Kaelber & Co., of Rochester, N. Y., have secured the contract for the electric call and speaking tube work in the new hotel now building on Exchange street in that city. This hotel is designed to be the finest in western New York; there will be 140 rooms, with calls and return calls, connected with a Western Electric needle annunciator in the office.

Recent advices confirm the statement made in the last issue that the embarrassment of the Vitrite & Luminoid company of New York will be only temporary. It is stated that the unsecured liabilities amount to only $8,000, that they will be paid in full and that the company will be reorganized.

F. E. Pettingell and G. T. Armstrong, gentlemen well known to the trade, have formed a partnership and will handle electrical goods of every description at 95 Milk street, Boston, Mass. Their friends will unite in wishing them all prosperity.

The Van Depoele Electric Manufacturing company has just closed a contract to equip the street railway at Wheeling, W. Va., with three eighty horse power generators and twelve fifteen horse power motors. N. Riester, J. M. Sweeney and others are interested in the street railway company.

The A. Plamondon Manufacturing company of Chicago have ordered another sixteen light plant of the Van Depoele Electric Manufacturing company, increasing their capacity to thirty-two lights.

The Brush Electric company, William F. Swift, secretary, have issued the following notice, dated November 5th: "Our contract with the Brush-Swan Electric Light company, of New England, has been terminated, and we have resumed control of the territory formerly occupied by it. Hereafter we will fill orders directly for parties residing in said territory, and all correspondence should be directed to the Brush Electric company, P. O. Box number 1772, New York city. No orders will be recognized by us hereafter coming through the Brush-Swan Electric Light company, of New England."

The United States Electric Fire Alarm company, of Evart, Mich., recently put in their system of fire alarms at Newaygo, and the chief of fire department, president, clerk and board of trustees, unite in signing the following voluntary testimonial: "The fire alarm telegraph system supplied by your company, and constructed under the supervision of S. A. Chase, took the place of our former telegraph fire alarm system previously constructed by other parties, and which had proved to be an entire failure. We are now pleased to say that your system appears to be complete in every particular. It has given perfect satisfaction at all times since its erection. Daily tests have been uniform and all right. We could not have a more perfect system."—*Evart Review.*

The boiler shop of the Woodbury Engine company, Rochester, N. Y., is full of orders. Among recent contracts made are the following: Ellwanger & Barry block, four boilers; the German Insurance company, three boilers; the Trust and Safety Deposit company, three boilers; Rochester Brewing company, three 100 horse power boilers; Bausch & Lamb Optical company, one 100 horse power boiler, a mate to the one put in a year ago; Rochester Paper company, one 150 horse power boiler; Stein Manufacturing company, a pair of 75 horse power boilers; the Citizens' Gas company, a 55 horse power boiler; the Howe estate, a 35 horse power boiler, all of Rochester, and another 100 horse power boiler for the Hartland Paper company.

Leonard & Izard, constructing engineers of Chicago, have started an Edison plant in the People's theater at Minneapolis. The plant runs 481 108-volt lamps of 16 candle power each, with 220 ampères. Indications show that a horse power is required by a trifle over twelve lamps. The lights burned for 10,000 lamp hours after first starting, with the breakage of but three lamps. The showing is a splendid one. The same firm has taken a contract for a central station, including street lighting, at Monmouth, Ill., and have received two more orders from the Chicago & Northwestern railway, one for a plant of 500 lights at Clinton, Ia., and the other for a plant of 700 lights at the depot in Chicago. The train shed will be lighted by an incandescent light, which is a complete change of the usual practice.

Leonard & Izard, of Chicago, are preparing an installation of a Julien storage battery to furnish the lights required for the art exhibition of the Calumet club in Chicago. There is an Edison plant in the club house, but the dynamo is of too small capacity to furnish the additional lights required for the art exhibition.

Electrical Patents.

Issued November 1, 1887.

372,313. Incandescent Electric Light Bulb. Robert Haines, Corning, N. Y.

372,330. System of Electrical Distribution. E. Wilbur Rice, jr., Lynn, Mass.

The invention relates to systems in which an alternating or reversed current is used to feed a number of incandescent lamps through the medium of induction coils or other transformers. The feeder lines contain reactive coils whereby the self-induction or reaction of the feeders may be varied.

372,334. Lamp-Post and Lamp. Frank A. Sawyer, Portland.

372,358. Electric Dynamometer. Jules Cauderay, Paris, France.

372,361. Electric Regulator for Hydraulic Elevator Systems. Leo Daft, Plainfield, N. J.

372,363. Steam and Electric Connection for Railway Cars. Benjamin R. Deacon, Montreal, Quebec, Canada.

372,378. Automatic Telephone Exchange. Thomas D. Lockwood, Melrose, Mass.

The invention relates to systems in which a main central station and an auxiliary central station are connected by a trunk line. The auxiliary group of subscribers do the switching between themselves and connect with the trunk line as desired, so as to be in connection with the main central station. The invention is secured by five claims.

372,404. Apparatus for Transmitting and Receiving Electrical Signals. Marcel Deprez and Bruno Abdank-Abakanowicz, Paris, France.

The invention is designed more especially for telephone exchanges and relates to the signal transmitters and receivers, the circuit connections and automatic switches used therewith.

372,409. Draft Regulator for Furnaces. Wilhelm Fischer and Theodor Stiehl. Essen-on-the-Ruhr, Prussia, Germany.

372,441. Coin-Operated Induction Coil. Percy G. Williams and Alfred W. Roovers, Brooklyn, N. Y.

372,447. Dynamo-Electric Machine. Charles Batchelor, New York.

372,455. Microtelephone. Charles Clamond, Paris, France.

372,468. Secondary Battery. Carl Hering, Philadelphia, Pa.

The salts used with the lead oxides must be highly soluble. The electrode consists of an oxide, salt or compound of lead, with an acid, alkali, or salt, such as nitric acid or sodium hydrate, which when united forms a highly soluble salt or compound of lead.

372,475. Automatic Telegraphy. William A. Leggo, Montreal, Quebec, Canada.

372,494. Sewerage System for Buildings. Charles H. Shepherd, New York, N. Y.

372,501. System of Electric Distribution for Alternating Currents. Elihu Thomson, Lynn, Mass.

Compensating or equalizing coils are connected by wires independent of the circuit over which the converters are supplied. The compensators are wound with fine wire and so connected that light may be turned out anywhere without affecting the potential of the remainder to a noticeable degree.

372,550. Apparatus for Covering Insulated Electrical Conductors. Edward McKnight, Philadelphia, Pa.

372,579. Coupling for Wires and Bands. Charles E. Tafflinger, Seneca Falls, N. Y.

372,598. Circuit System for Electric Brakes. George F. Card, Covington, Ky.

372,599. Coupling for Electric Brakes. George F. Card, Covington, Ky.

372,637. Coupling for Electric or Other Wires. Frank S. Pond, Woonsocket, R. I.

372,647. Electric Belt. John Williams, Hartford, Conn.

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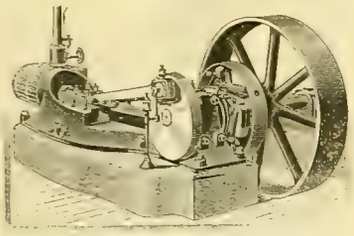

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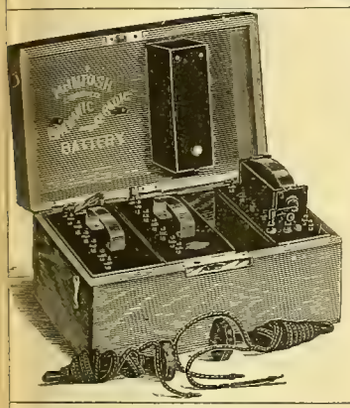

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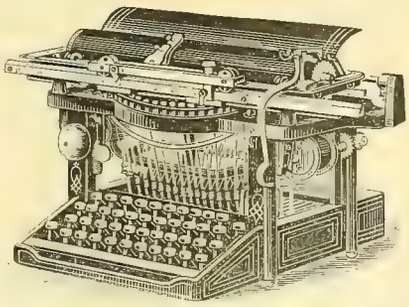

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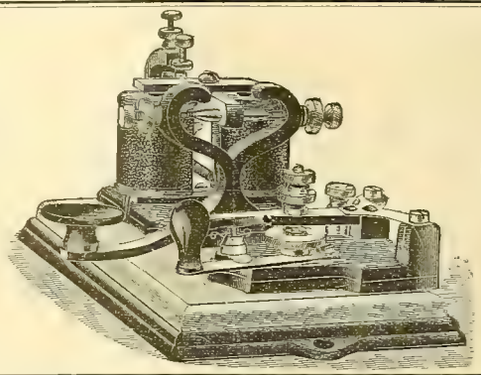

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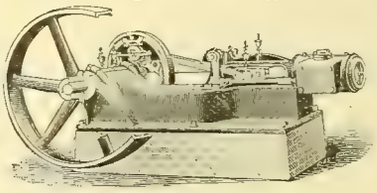

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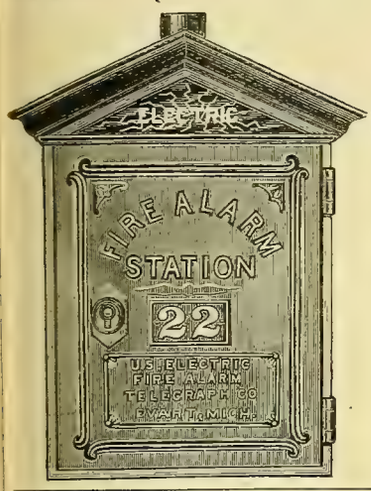

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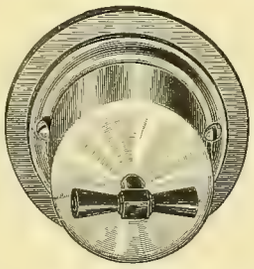

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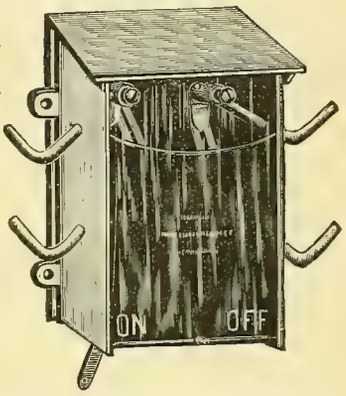

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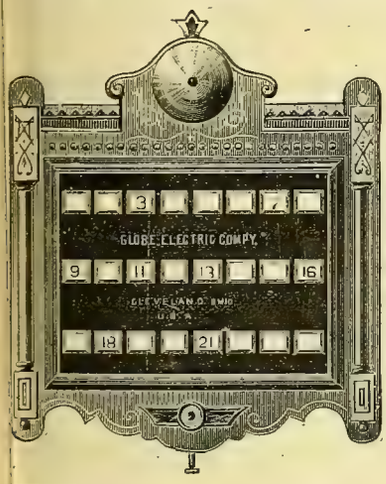

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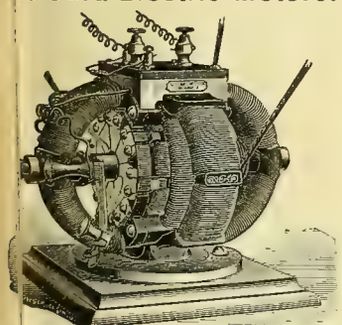

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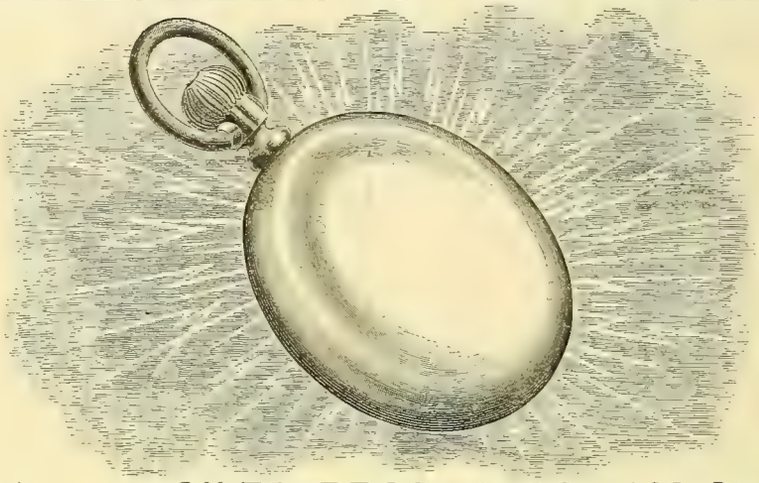

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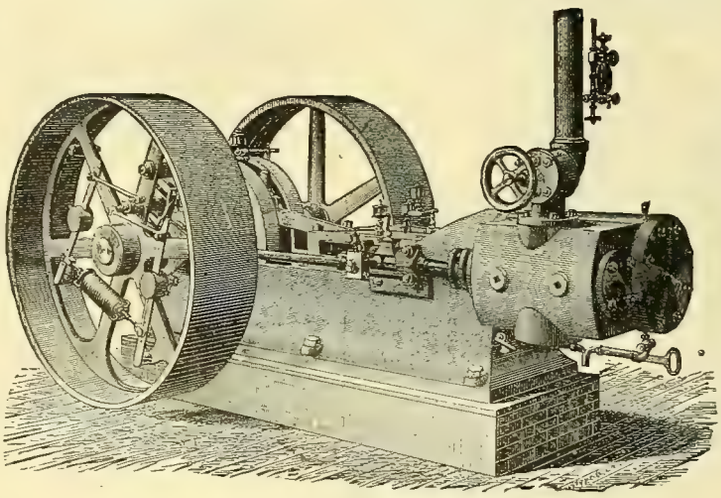

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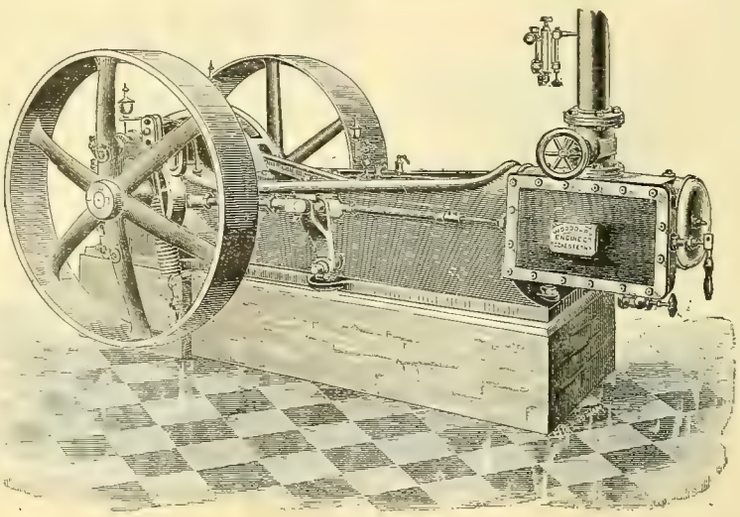

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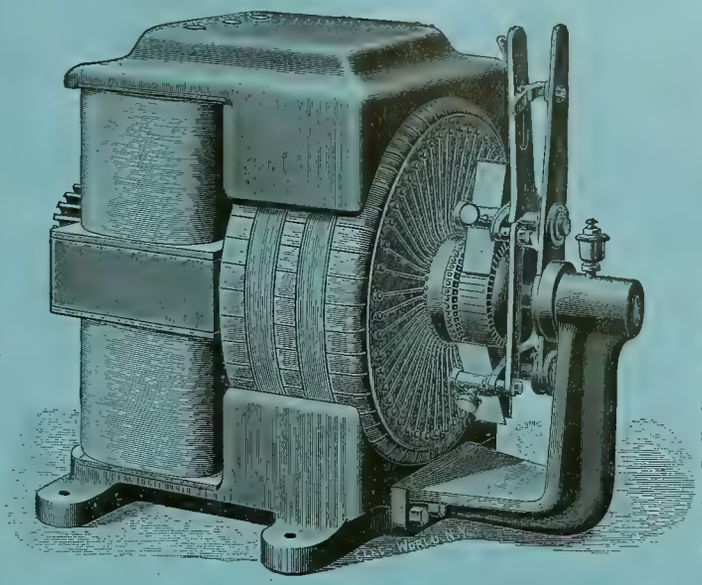

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By reason of its new Automatic Regulator that does not depend on merely shifting the brushes, but cuts out a portion of the field magnets as each light is turned off, saving the power in proportion to number of lights burning down to one light.

Dynamo is the simplest of all makes and requires no attention except to keep it clean. The lamps are ornamental, can be used in connection with any system from seven to fifteen amperes without change of magnets.

The first and only system where Incandescent lights are successfully running off Arc Light Circuits.

Twenty-five dollars will repair our dynamo in places that cost seven hundred dollars on other systems.

Our system is original, and not copied after foreign obsolete patterns.

Our prices are reasonable.

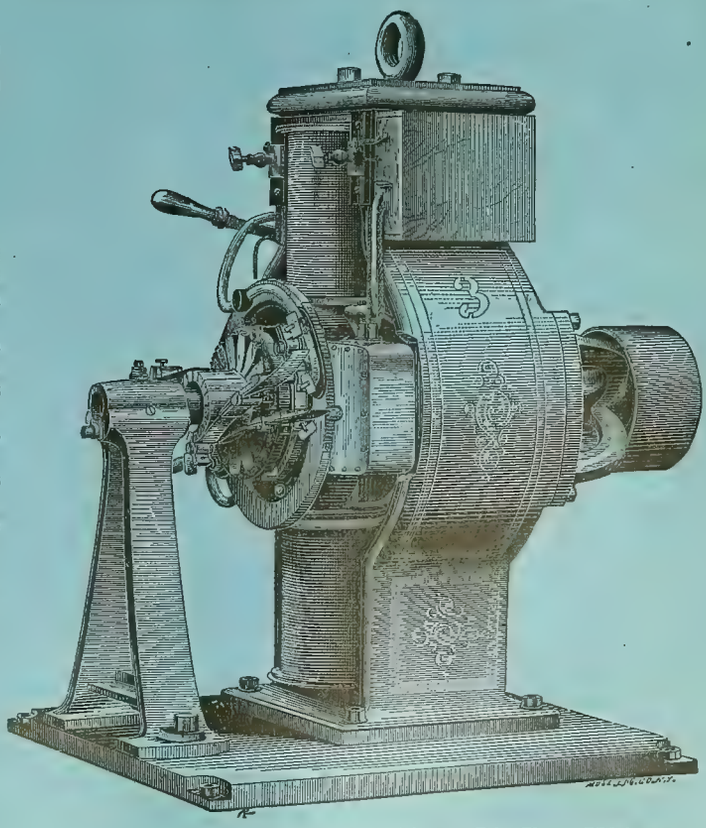
The only system that has local companies paying 40 per cent. and above on its capital stock.

We take the contract wherever we bid.

Address

F. W. HORNE, Western Manager,

EXCELSIOR ELECTRIC CO.,



185 Dearborn Street, Rooms 13 and 14. CHICAGO, ILL.

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DIRECTORS:
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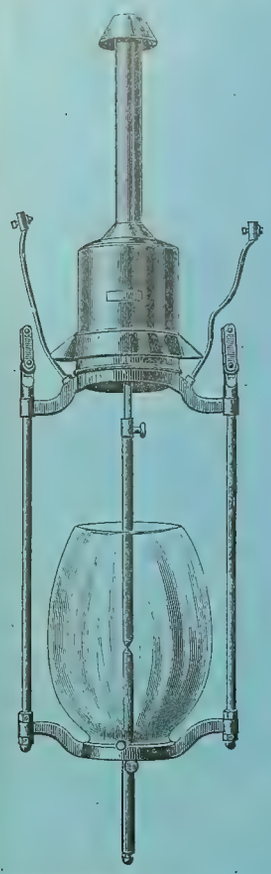
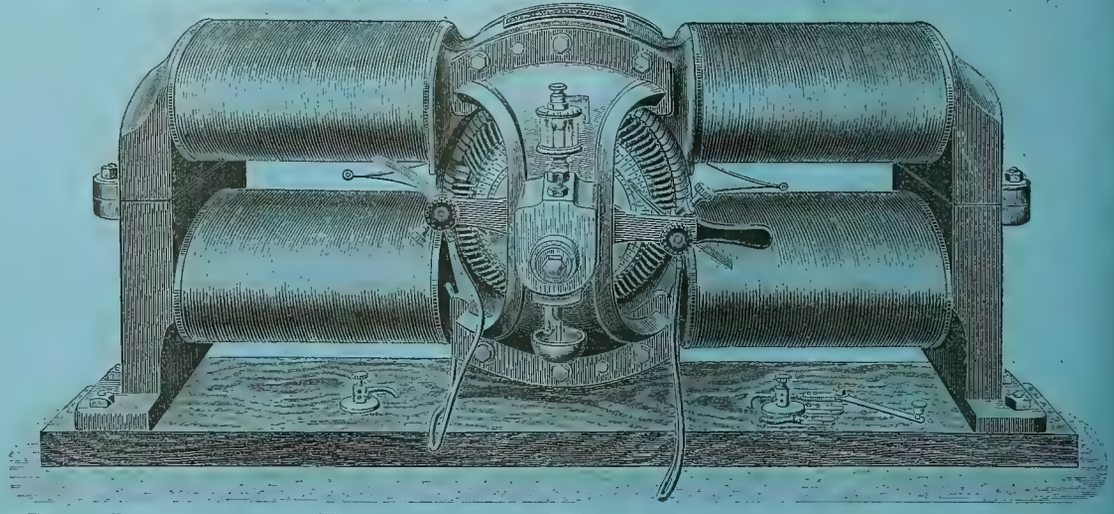
Fort Wayne "Jenney" Electric Light Co.,

SOLE OWNERS AND MANUFACTURERS OF THE





J. A. JENNEY DYNAMO-ELECTRIC MACHINES,

AND THE PERFECTLY AUTOMATIC AND SELF-REGULATING

JENNEY ARC LIGHT.

The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

ONLY GOLD MEDAL

At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

This system HAS NO EQUAL for SIMPLICITY, DURABILITY and STRENGTH OF LIGHT.

We have the Only Perfect Working Headlight for Steamboats, with Focusing Reflector. Full information furnished on application.

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CHICAGO AGENT: ALEXANDER KEMPT, 130 Washington Street.

The Brush Electric Company

—OF—

CLEVELAND, OHIO,

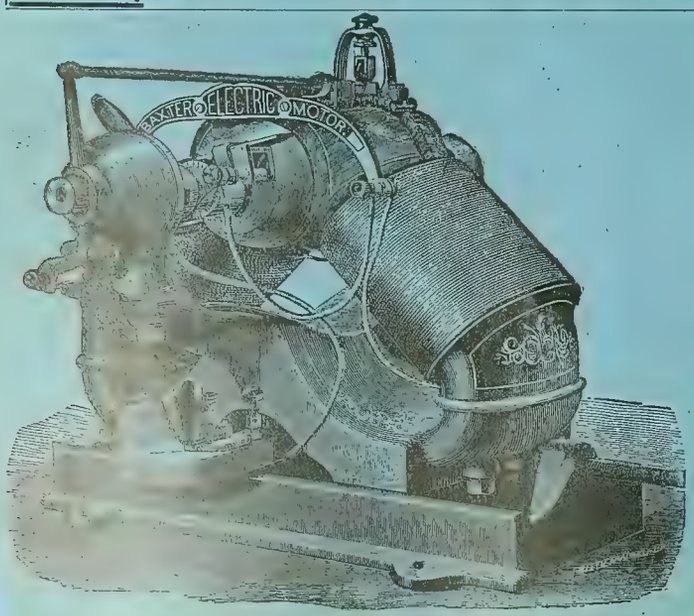
MANUFACTURERS OF

Brush Arc AND Incandescence Electric Lighting Apparatus,

ELECTRIC MOTORS,

Carbons for Arc Lamps, Etc., Etc.

OMAHA AGENT: E. G. TUPPER, 1509 Farnham Street.



The Baxter Electric Motor.

This Motor is now ready to be placed upon the Market.
Manufactured for both

Arc and Incandescent Circuits,

THE ONLY PERFECTLY GOVERNED MOTOR EVER MADE.

CORRESPONDENCE SOLICTED.

Address:

THE BAXTER ELECTRIC MANUFACTURING AND MOTOR CO.,

11 SOUTH STREET, BALTIMORE, MD.

Factory A, Constitution and Monument Sts. Factory B, Buren and Monument Sts.

Western Electrician.

EVERY SATURDAY.

Vol. I. CHICAGO, NOVEMBER 19, 1887. No. 21.

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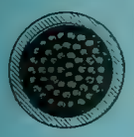

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General Offices, No. 708 PENN. AVE., PITTSBURGH, PA.

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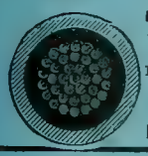

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The WARING ANTI-INDUCTION AND BUNCHED CABLES AND ACHESON COMPOUND CABLE.

For Telegraph, Telephone, Electric Light and Power; Underground, Submarine and Aerial.

Light Leaded Cables for House Use.

Five Years of Uniform Success Enable us to Guarantee our Cables.

DAY'S KERITE INSULATION.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling. All Sizes *Lead Encased Wires.* Aerial Use, Subterranean Use, Submarine Use Concealed Wiring in all Locations.

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The CALLENDER INSULATING and WATERPROOFING COMPANY,

45 Broadway, New York.

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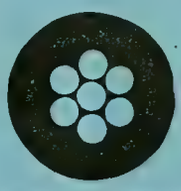

BITITE and TRINIDAD

INSULATED WIRES AND CABLES.

Bitite Wires for Use Underground, in Plaster, Damp Places, Etc., Etc.

TRINIDAD WIRES for Line Work in place of Underwriters.

ELECTRIC LIGHT WIRES of all sizes a SPECIALTY.

The Chicago Electrical Development Co.

PROMOTERS OF ELECTRICAL INVENTIONS.

Patents bought outright, or inventions handled on royalty.

We have superior advantages for placing patented articles on the market.

Correspondence with inventors solicited.

171 RANDOLPH STREET, CHICAGO.

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THE ELECTRICAL SUPPLY CO.

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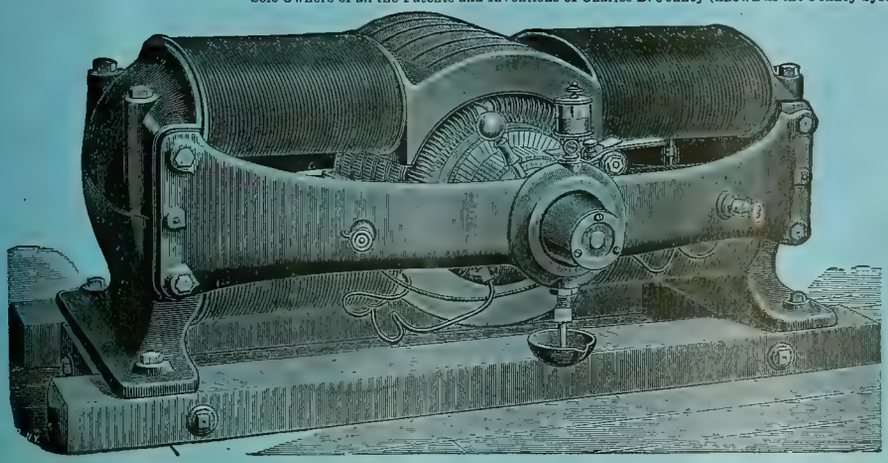
JENNEY ELECTRIC COMPANY.

OF INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp & Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Arc-Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

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INDIANAPOLIS, IND.

The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

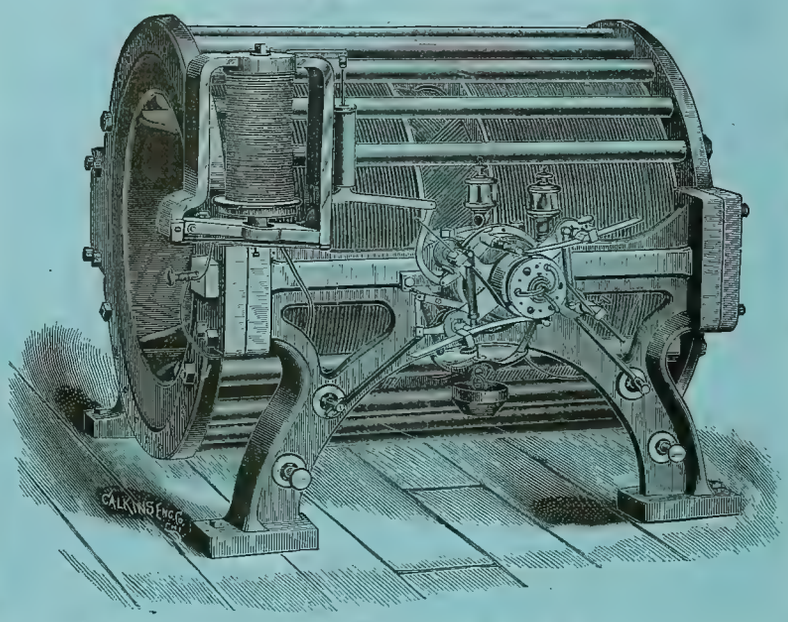
OF

Electric Arc-Lighting

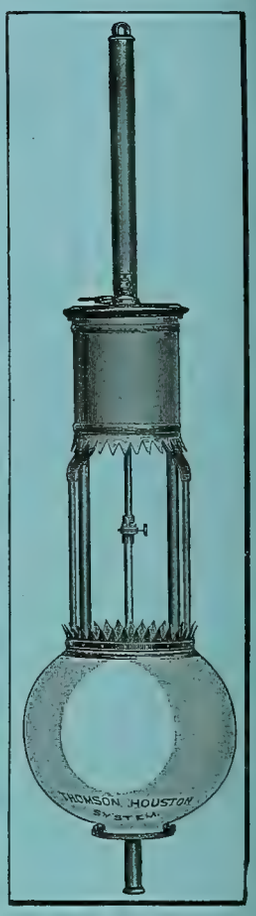
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

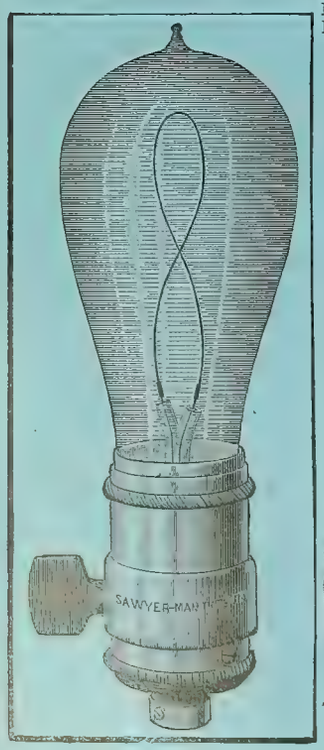


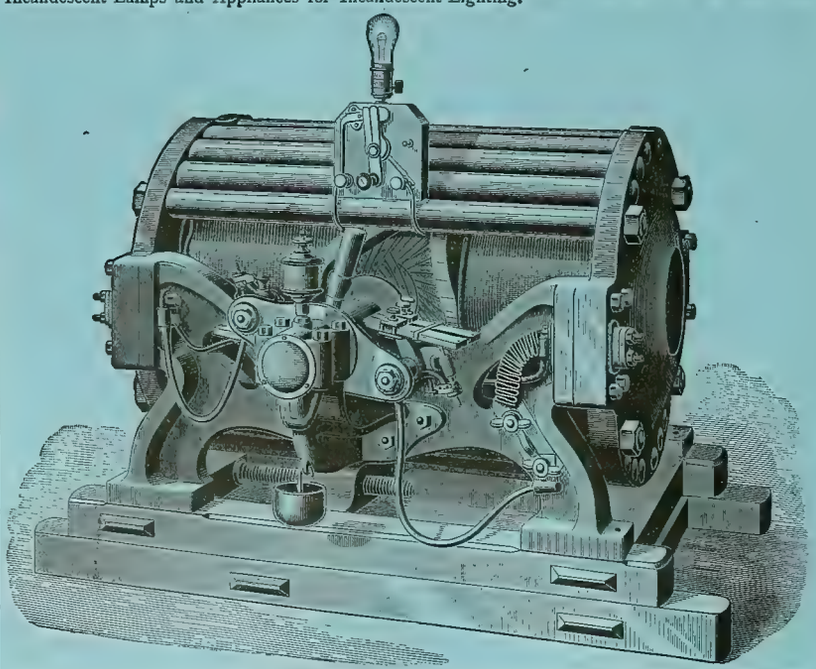
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

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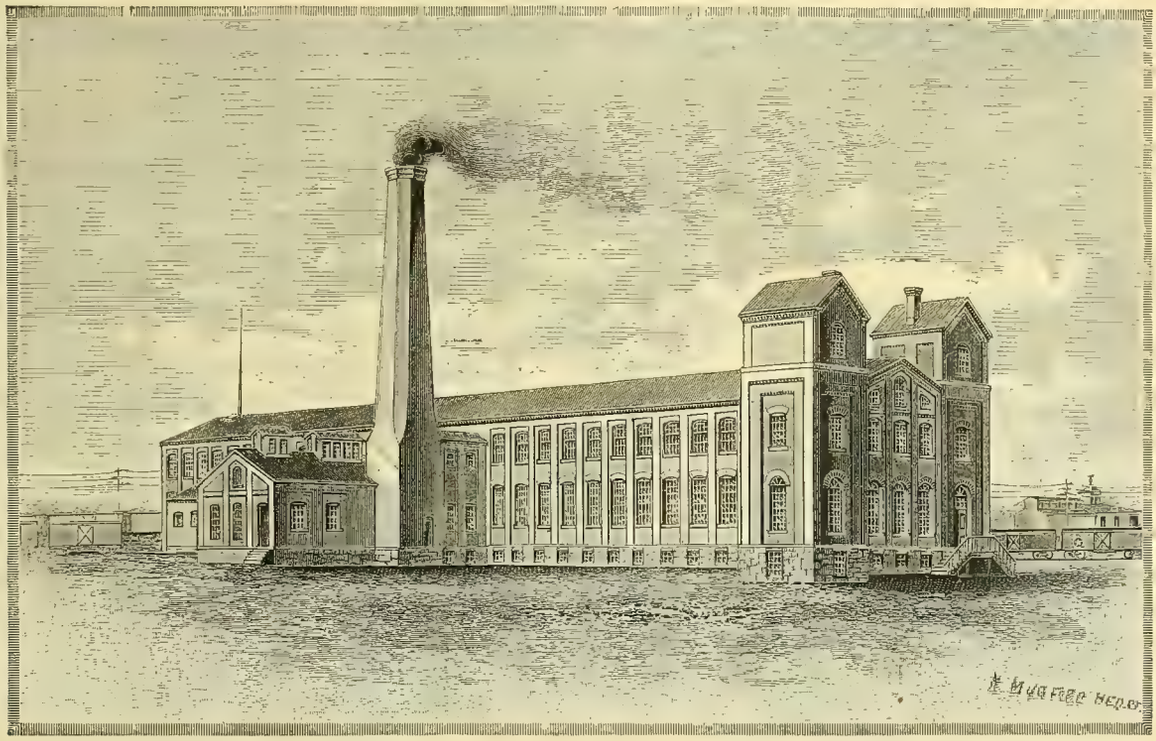
R. H. MATHER, WM. A. ANTHONY, Consulting Electricians.

New York Office, 35 Broadway. Chicago Office, 38 LaSalle St. Boston Office, 143 Federal St. Cincinnati Office, Carlisle Building.



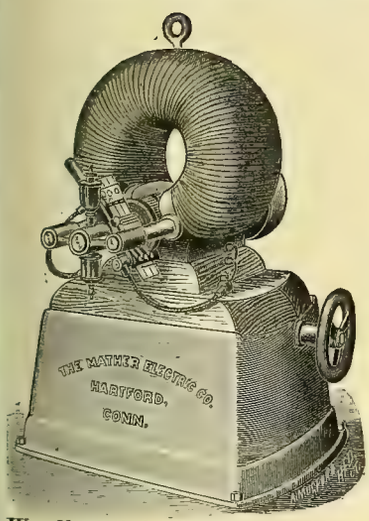
INSTRUMENTS OF PRECISION.

We make instruments for Electrical Measurements, adjusted to any degree of precision required for any purpose. Resistance boxes are made with any required series of resistances, with and without proportional coils for bridge. All resistances are adjusted to legal ohms by standards tested at the Cavendish Laboratory and certified by the British Association Committee.

IN RESISTANCE BOXES

required for physical research, all the coils will be made from one piece of wire, to insure a uniform temperature coefficient. Galvanometers are made of high and low resistance, aperiodic and astatic, or not, as required. Tangent Galvanometers of any capacity will be made to order. Ammeters, Voltmeters and Resistance Coils will be calibrated, and constants furnished.

The Mather System for Incandescent Lighting.



The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and

DO NOT BLACKEN IN USE.

Our Dynamo is very simple in construction, runs without spark at the commutators and can be operated by any one accustomed to the care of engines or machinery. The system has no equal for mills, machine shops, or other places requiring isolated plants. We shall be pleased to furnish estimates for complete installations, with or without motive power, and will send one of our experts to examine the premises, if necessary.

MOTORS.

We furnish motors from one-half horse power upwards, for constant potential circuits, perfectly self-regulating without special regulating mechanism. Motors are also furnished for constant current circuits.

Incandescent Lamps and Sockets for Private Users.

We Furnish Lamps of 16 Candle Power each, for Potentials from 50 to 110 Volts, for use with any Machine.

Chicago Office, 38 LaSalle Street.

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35 Broadway, New York City.

Sole Agents of the MATHER ELECTRIC COMPANY for the States of New York, New Jersey, Missouri and Iowa.

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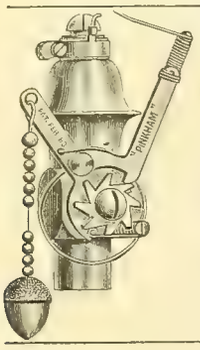
MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



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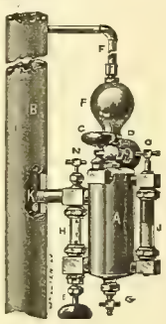
Patent Lift-Over Pendant Burner.

The Pendant Burner has the **Patent Lift-Over Electrode,** which saves half the battery power and avoids short-circuiting which is liable to occur in many others.

The Lift-Over Electrode is a very important feature no other Pendant has.

The Improved Automatic and Pendant Burners are guaranteed to be reliable, safe and of first class workmanship.



The Detroit Sight Feed Lubricators

Are pronounced the best by more than **20,000** users. They are especially adapted to

HIGH SPEED ENGINES FOR ELECTRIC LIGHTING

Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

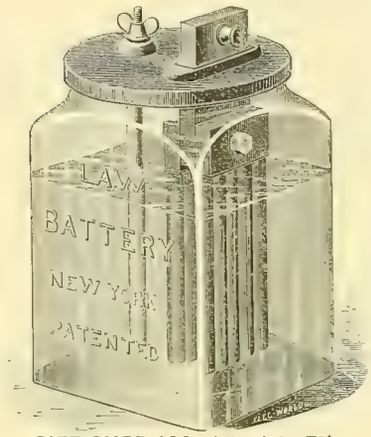
"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

Liberal discount to the trade. Send for Circular and Price List.

DETROIT LUBRICATOR CO.

Office, 11 Rowland Street, - DETROIT, MICH.

THE IMPROVED "LAW PRISM" BATTERY



SIZE OVER ALL, 4¼ x 4¼ x 7½.

THE NEATEST OF ALL BATTERIES. THE BEST AND CHEAPEST.

With the exception of glass broken by carelessness, and the zinc and sal-ammoniac consumed in the production of current, **all parts of this Battery are Guaranteed** to be **Everlasting.** Perfectly **uniform** and **reliable** in action, of **faultless construction** and **beautiful appearance.**

PERPETUAL NEGATIVE ELEMENTS!!!

These consisting of specially prepared prisms of Carbon are fine depolarizers, performing this function indefinitely, **do not require renewal,** as is the case where chemical depolarizers are employed, thus a **great economy** is effected. These cells are so constructed as to prevent evaporation of the solution, and crawling out of the salts. Thousands of these cells now employed for **Telephone Transmitters, Gas Lighting, Annunciators, Burglar Alarms** and other **Automatic Devices** are giving **Perfect Satisfaction.**

The many Physicians now using the **"Improved Law"** as an office battery, are unanimous in their expressions as to its perfection and adaptability for electrolysis and general galvanization, requiring no renewal nor attention in from two to five years, the latter depending only on the amount of use.

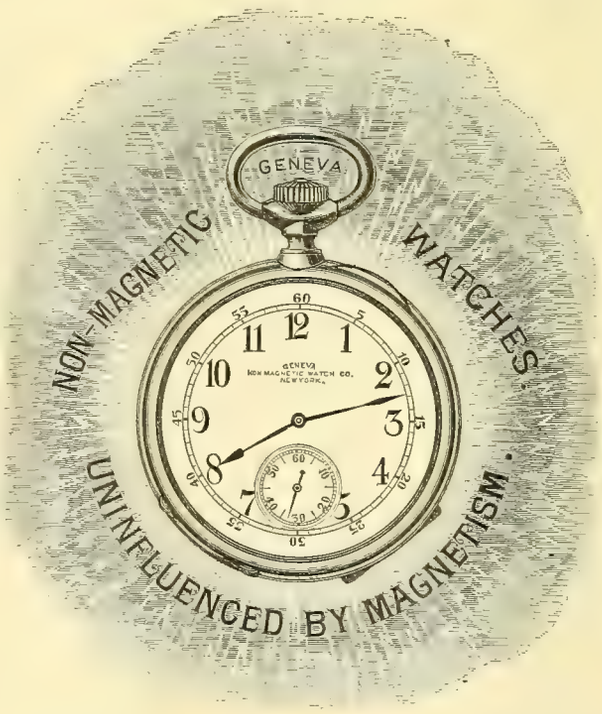
Note:—This battery is not suitable for Galvano Cautery nor Incandescent Light purposes.

LAW TELEPHONE CO., Sole Manufacturers, 112 LIBERTY ST., NEW YORK.

Geneva Non-Magnetic Watch Co.

(LIMITED.)

Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode.



Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the works, they require no shield or other protection.

Ask your Jeweler for them.

Send for Catalogue.

177 & 179 Broadway, New York.

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ENGINEERS AND CONTRACTORS OF

Steam and Hydraulic Machinery.

Complete Steam Plants for Electric Light and Power.

Western Agents for Armington & Sims' Engines, Steel Tubular Boilers, Jarvis' Patent Furnace, National Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Jenkins' Bros. Valves, Etc. Also, Brick and Pipe Work, and Belting.

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MANUFACTURERS OF

Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

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Western Agency, 185 & 187 Dearborn St., Chicago.

PAYNE AUTOMATIC ENGINE.

B. W. PAYNE & SONS, MANUFACTURERS, ELMIRA, NEW YORK.

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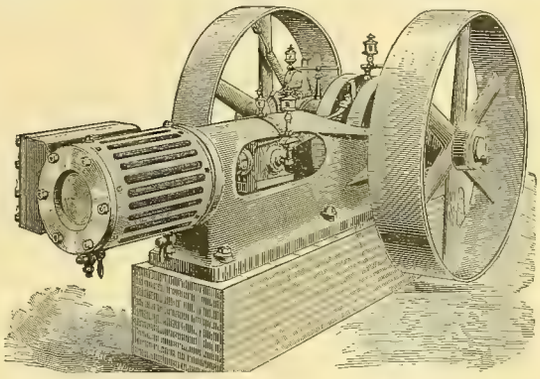
Single Valve and Corliss Valve

ENGINES.

SELF CONTAINED AND SINGLE CRANK

ENGINES

Specially Adapted for Electric Lighting.



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CHICAGO.

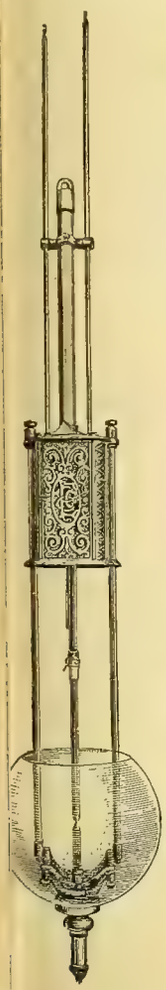
H. S. WALKER, MANAGER.

TELEPHONE 4024.

GEO. D. ALLEN, GEN'L MGR., WM. HOCHHAUSEN, SUP'T AND ELECTRICIAN.

Excelsior Electric Company,

9 Dey Street, New York. Factory, 204 to 216 Willoughby Street, Brooklyn, N. Y.



Excelsior Electric Light

TO THE FRONT

By reason of its new Automatic Regulator that does not depend on merely shifting the brushes, but cuts out a portion of the field magnets as each light is turned off, saving the power in proportion o number of lights burning down to one light.

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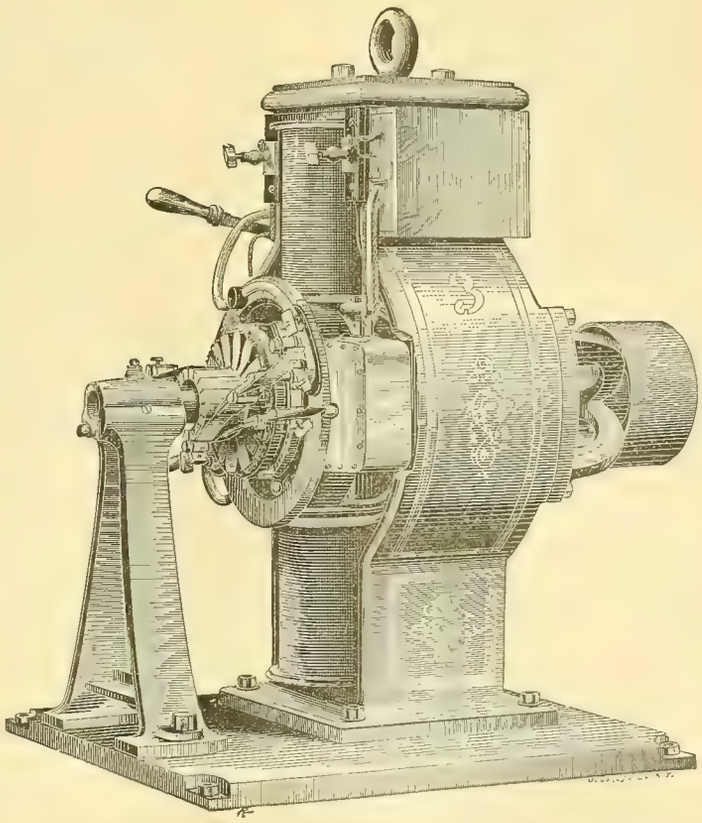
F. W. HORNE, Western Manager,

EXCELSIOR ELECTRIC CO.,



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DISQUE LeCLANCHE BATTERY.

We make the best Disque LeClanche Battery in the market, and guarantee it.

We will replace, without charge, any porous cup which fails to give satisfactory service within nine months from the date of its manufacture, if the cup be returned to us sound and whole.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

THE EDDY ELECTRIC MANUFACTURING CO.

MANUFACTURERS OF **Automatic Electric Motors** (MATHER PATENTS.)

In all sizes from ½ H. P. upwards. The efficiency of these Motors is over 92 per cent. They require no rheostat, are perfect in regulation, simple in construction, and thoroughly and substantially built. Also manufacturers of

THE MATHER DYNAMO ELECTRIC MACHINE,

FOR ELECTRO-PLATING, ELECTROTYPING, COPPER REFINING, ETC.

These Machines cannot reverse, use no water, do not spark, and are noiseless. Satisfaction Guaranteed.

THE EDDY ELECTRIC MANUFACTURING CO., HARTFORD, CONN.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."

J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT,
THE U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously insyalled by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volt
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 300 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C. C. Warren Esq.

Dear Sir. I have written the answers opposite your questions above as per your request, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful state of the Syndicate Block plant is no surprise to me.

Yours truly, J. F. Conklin.

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, NOVEMBER 19, 1887. No. 21

New Combination Sets.

Every electrical man of any experience must frequently have felt the want of a light portable combined testing set that could be easily and conveniently carried without spilling the solution, to make rough and approximate tests outside, and that would be always ready for action and enable him to locate faults, test condition of batteries, prove circuits, test wires and detect faults. Many telephone men appear to be content with the click of a telephone to test and prove connections, but the click of a telephone may mean anything, and many hundreds of ohms resistance may be introduced into the circuit, making it actually unworkable, without any perceptible difference in the click, and such test, at the best, must be very misleading; whereas the detector needle would show a trifling increased resistance existing between connections, and although no actual measurement can be taken, a person accustomed to the use of a detector can tell approximately from the indications whether the resistance between one point and another tested, is what it should be. For instance, in testing roughly the condition of batteries, say LeClanché, when it is known that one cell in good condition will deflect the needle say 60°, any other cell of the same battery giving a lower deflection would necessarily be defective. In testing apparatus, the fall in the deflection on the galvanometer when connected to the ends of a covered connection, which should have no perceptible resistance when in good condition, proves the existence of a fault. The approximate resistance of electro-magnets employed by telegraph and telephone companies is known to the men whose duty it is to remove the faults. If then the resistance of a type of telephone call bell is 100 ohms and the pointer when galvanometer and battery are connected through one gave a deflection of 30°, with the same battery and detector the deflection should always be the same in testing any of the same type or make of bell, provided it is in good condition, and the connections sound. The useful applications to which the combination testing set, made by the Globe Electric company, Cleveland, Ohio, and shown in Fig. 1, may be applied, are numerous. The galvanometers are made with one, two or three coils of different resistance, as low, intermediate and high. The one illustrated has but one coil as indicated by its having only two binding posts. The apparatus is handsomely gotten up in polished ebonite or hard rubber, with electroplated mountings, and a hand strap by which it may be carried or hung up out of the way when not required for use. The battery is a modified LeClanché, perfectly sealed except at the vent, which by means of the milled head is opened or closed.

Fig. 2 represents a semi-portable three-way annunciator bell and battery with three pushes of various sizes and shapes, each connected with a 40 feet length of flexible cords of different patterns. The case and battery are of polished hard rubber, the mountings are electro-plated and the gong is 3½ inches diameter. In this set there is a complete electric bell equipment for a small house which may be installed in a few minutes by any person not having any electrical knowledge whatever. The flexible cords may be replaced by permanently fixed wires, and the annunciator bell and battery securely hung up in any convenient place as a fixture. A three-way drop indicator with the drops inclosed in the case but showing outside and having mechanical replacement, is a modification of this apparatus; all the working parts are well designed.

Fig. 3 is a combined sounder, key, switch and battery for operating on short lines and for the use of learners.

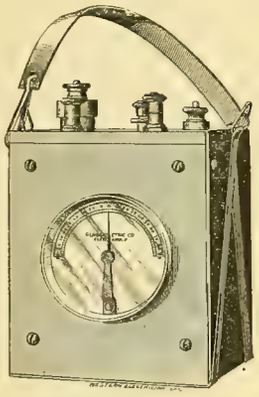


Fig. 1.

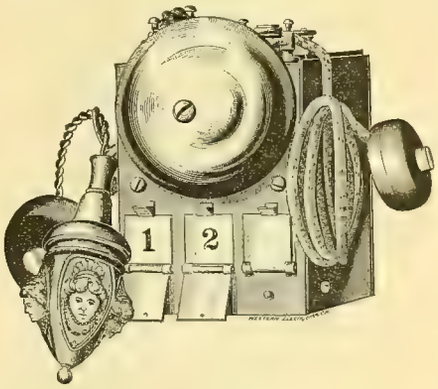


Fig. 2.

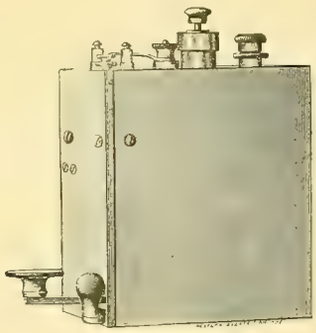


Fig. 3.

Long Distance Telephony.

A New York reporter last week chatted by telephone with gentlemen in Philadelphia as easily as if talking through the speaking-tube from the editorial rooms to the business office and hung to the incident some interesting statements of the accomplishments of the American Telephone and Telegraph company. He writes: Long distance outfits are being rapidly placed for interchange of communication between big cities and suburban places. The list includes Boston, Philadelphia, Providence, Camden, Stamford, Norwalk, Danbury, Bridgeport, Ansonia, Waterbury, New Haven, New London, Meriden, New Britain, and Hartford, Conn.; Springfield, Holyoke, Chicopee, and Worcester, Mass. There are nearly one hundred stations from the Battery to Harlem, where anybody can talk on social or business topics with subscribers in the places listed. By means of the terminal connecting lines New York business men can be placed in immediate and direct speaking communication with any of the subscribers to the telephone exchange in Philadelphia and the cities and towns in this state, New Jersey, Connecticut, Massachusetts and other states. Very heavy lines are now being constructed to points in New England and to Albany.

The Boston circuit will be opened in three weeks, with thirty wires, and the communication will be as direct as it is now between this city and Philadelphia. It is expected that the service to Albany will be opened Jan. 1st. One hundred pole raisers began work in August at Albany, and they reached Hudson last week. At the same time another force went to work at this end and are at Poughkeepsie. The river road of the west shore is followed. The poles are from forty-five to fifty feet high, and so strong that from fifty to seventy wires can be strung with safety. The wire stringers will be put to work this week. Twelve copper wires will be placed at first, and the cost of the wire is estimated at $90,000. The entire cost of connecting New York and Albany is estimated at $300,000. The Hudson river here and at Albany will be crossed by cables. When the circuit is established between the two cities the lines will be extended through the state to Buffalo, to Cleveland, to Cincinnati, and to Chicago.

The New York broker will be in ecstacy when he can have a personal interview with his Chicago representative at home. Tests recently made show that such a performance is entirely practicable. There are newspaper offices in this city and Philadelphia furnished with long distance outfits, and news matter is transmitted daily. The correspondent here calls his paper and dictates his facts, which are written down by a colleague, and the copy goes direct to the editor. In this and other respects the long distance telephone threatens to be a formidable rival of the telegraph Many suburban manufacturers, with New York offices and branches, have adopted the long distance telephone and find it invaluable.

Time and distance are the basis of charges for the use of the long distance telephone. It is becoming popular for several firms to combine and rent a wire between distant points. If there are three firms in the combination they mutually arrange a schedule, each firm agreeing not to take more than twenty minutes an hour. Single wires from here to Philadelphia, to be used between 4 p.m. and 2 a.m., are rented for $100 a month. This includes two outfits and repairs. There are repair stations every forty miles along the lines. The Boston wires will be worth $200 a month and those to Albany less. Those who have watched the development of the telephone are enthusiastic over the possibilities of the long distance system, and say it is destined to work a revolution in professional and commercial circles.

There is a story told of a recent achievement with the invention by a certain railroad. The company got up a new time table which was put in type two hundred miles from the executive office here. The proof was read and corrected by copy over the telephone wire with almost as much facility as if the company's representative had been in the printer's office.

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number XVIII.

ELECTRIC TERMS AND UNITS.

Before entering upon an investigation of the principles which govern the construction of electric lamps it is proper to define more fully various technical terms in common use in electric science, most of which have already been frequently used in these articles, accompanied, as introduced, by brief definitions. This is the more important since their full import is not always clear, even to many who daily use them.

Electric Potential. — Potential is a convenient term used in various departments of physical science to represent the energy which a body may possess to accomplish work. A weight has gravity potential when it occupies such a position that it can accomplish work by its descent; a furnace heat potential when it can accomplish work by its heat. So practically, without reference to mere theoretical distinctions, electric potential is the power which a body possesses to accomplish work by virtue of its electricity. But to accomplish work by gravity, heat, electricity or other energy there must always be a difference of potential, since in equality of potential the forces are equally balanced; a weight requires difference of level, heat, difference of temperature. So electricity can accomplish no work where the opposing electric conditions are equal; and the object of any electric generator, whether it be a battery, dynamo, or static machine, is not to create electric energy, which is a physical impossibility, since like gravity it exists as a universal property of matter, but to create a difference of electric potential.

Positive and negative are convenient relative terms to express differences of potential. A body is said to be positively electrified when by electric accumulation its potential rises above that of other bodies to which it may be related, either by contiguity of position or electric connection, and negatively when its electric potential is below that of the other bodies.

Electromotive Force.—Electromotive force is the force or pressure which electric energy is capable of exerting by virtue of a difference of electric potential between the body in which it is accumulated and some other body. The force or pressure is exerted by the energy itself, the body in which it is accumulated or by which it is transmitted being merely a passive medium, and not, as in the case of steam and some other bodies, the active medium by which the energy is applied.

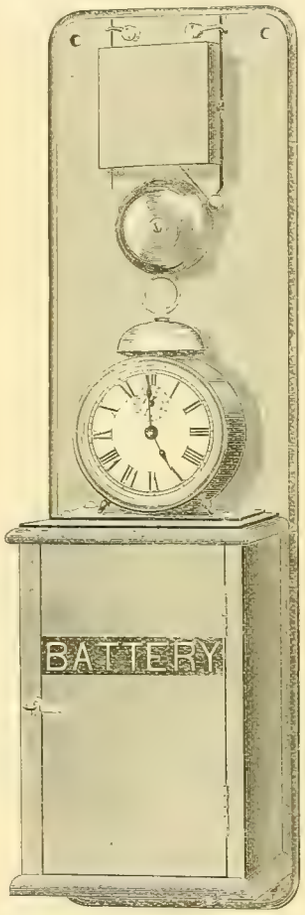
The term *pressure* has recently come into use in this connection, and perhaps expresses more clearly what takes place than any other term which can be found. It is the energy accumulated in steam, heated air, a descending weight, or a waterfall, which creates the pressure by which work is accomplished; and similarly, by its own peculiar process, electricity creates pressure and accomplishes work.

The symbol for electromotive force is e. m. f., and in mathematical formulæ E alone is generally used.

Resistance. — Resistance is that which opposes electromotive force; it may consist in counter electromotive force, in useful work to be accomplished, in the imperfect conductivity of the conductor, or in an artificial obstruction placed in the circuit for a given purpose. It is important to distinguish carefully between internal resistance, which pertains to the generator or any electric instrument, and external resistance which pertains to the general circuit. R is the symbol of resistance, and where both kinds are referred to in the same connection, r is used to indicate the internal, and R the external resistance.

Current. — Current is that electric condition in a conductor which results from electromotive force modified by resistance. It pertains exclusively to what is understood as electric movement, and is used in the same sense when applied to this movement in a conductor, as when applied to the flow of water in a pipe; and in this sense also are used the terms current intensity, quantity, volume, strength and resistance; and on this principle all the various kinds of electric apparatus pertaining to current are constructed, and current estimates and measurements made. In the present imperfect state of electric knowledge this is doubtless the best that can be done, and yet it is doubtful whether there is any real resemblance between an electric current and a liquid current. The generator creates e. m. f. at one end of the conductor, and a molecular movement is supposed to take place by which electric energy is instantly transmitted. Theoretically this molecular movement is in the form of transverse vibrations, but as a matter of fact its nature is unknown. It seems to be well established, however, that there is no transmission of anything in the nature of a fluid or other matter, energy alone being transmitted, using matter as its medium.

Current movement is always from higher to lower potential. or which is the same thing, from positive to negative. Hence since e. m. f. depends on difference of potential the volume of current passing through a circuit of no resistance from the positive to the negative side of the dynamo depends solely on the amount of this



difference. But when the circuit includes lamps or other resistance the volume of current depends on the e. m. f. divided by the resistance, according to Ohm's law, the case being analogous to that of water flowing through a pipe under pressure and resistance. Hence any variation, either of e. m. f. or resistance, changes the volume of current; and where current constancy is required, as in electric lighting, it can be obtained by varying the e. m. f. in the same ratio as the resistance; and this, as we have seen, is done, in most cases, by shifting the position of the brushes on the commutator, in others by varying the number of armature or field magnet coils in circuit. The volume of current can also be varied by varying the resistance of a weaker opposing current, as has been shown.

To the ordinary mechanic or business man, accustomed to deal with material forces and unversed in philosophic subtleties, the movement of electric energy in a conductor is often a profound mystery. He naturally associates energy and matter so intimately that he is unable to discriminate between them, or to conceive how energy can traverse a conductor unless it is a material substance of the nature of a fluid. And until recently philosophers found the same difficulty; hence the terms phlogiston and electric fluid, representing imaginary material substances, the supposed active principles of heat and electricity.

But while we do not know just how electric energy is transmitted, it is not difficult to conceive how it may be, since we have analogous instances; and the theory most generally adopted is that of vibration, which is the more probable since it is equally applicable to the kindred forms of energy, light and heat. According to this theory the molecules of the conductor are thrown into a state of intense vibration, transverse vibrations traversing it, and transmitting the energy in a manner analogous to that by which mechanical energy is transmitted through a series of suspended balls, or along the surface of a liquid.

The symbol of current is C, and the conductivity of a conductor, that is its current capacity, without reference to the material of which it is composed, is inversely as its length, and directly as the area of its cross section.

Thomas' Electrical Alarm Clock.

The cut shown in connection illustrates a portable electric alarm clock made by H. G. Thomas of Boston, Mass. The apparatus consists of an alarm clock, electric bell and battery, all of which are mounted upon a single base. The feature of the construction is a continuous alarm at any prearranged time. The electrical connection is made by the hammer of the local alarm falling upon a pin, which prevents the hand from vibrating, thus forming the circuit, and the bell will ring continuously until the hammer has been released from the pin.

Higher Education in Japan.

By K. Sawai.

The Imperial University of Tokio is the only university in Japan, and is supported by the government. It was organized by the consolidation of three colleges, Tokio university, Imperial engineering college, and Medical university, most of which have existed for more than fifteen years. They gradually came to a state of perfection, and, at present, we think are in no way inferior to foreign universities.

The Imperial university consists of five departments, law, medicine, engineering, literature and science. Their minor divisions are:

Law department—Law, politics and economy.

Medical department—Medicine and surgery and the compounding of drugs.

Engineering department—Mining, metallurgy, applied chemistry, electric engineering, civil engineering, mechanical engineering, architecture, shipbuilding.

Literature department — History, philology, pure literature, Japanese literature and philosophy.

Science department — Astronomy, physics, mathematics, botany, zoology, mineralogy, geology, anthropology, pure chemistry and seismology.

The number of professors, assistant professors and lecturers is nearly 200, of whom nearly twenty are foreigners; the remainder are native professors. Most of the native professors have been in foreign countries for special studies. The university has nearly six hundred students in addition to many elective course students. The number of graduates is nearly five hundred, and they are mostly either occupying important positions in Japanese society and government, or else pursuing their special study in foreign countries. In a word, the university is doing a great service to our country.

The scholars admitted to this university must either be graduates of ordinary colleges, or else have equal ability with the graduates. There are five of these colleges in the country, and they give a general education all through in English. The course is four years long, and the pupils are taught mathematics, English literature and elementary sciences.

The course of the university is also four years long. The student generally selects one of the five departments of study the first year of the course, and the remaining three years pursues his specialty.

The students who graduate from the university after a four years' course, obtain the title of Gakushi, which might correspond to your bachelor of arts.

After the graduation some take a post graduate course, which might be a year or two. At the end of this course the student again writes an essay on the subject which he has followed, and after successfully passing an examination receives the title of Hakase—something like your doctor.

Of course, examinations are generally difficult, and students are usually very studious and hard workers. As the government gives quite a large sum of money every year to support the university, the student can get along very nicely at a comparatively small expense. Moreover, there are many governmental and private scholarships, so that even a son of a poor farmer can secure a free scholarship, provided he has ability. And I think this is one very good point of our university compared to foreign universities.

The students are mostly taught in English, with the exception of some parts of the law department which is taught in French, and of the medical department which is altogether taught in German. The students can usually speak two foreign languages, and some three. We have a well stocked library, laboratory, museum, botanical garden, astronomical and meteorological observatories. The number of periodicals and journals we are receiving is more than 700 in number, and among the papers relating to electric engineering, we have: WESTERN ELECTRICIAN, *Wiedemann's Anallen*, *Der Electricitäte*, *Elektrotechnische Zeitschrift*, *Centralblatt für Electro-technik*, *Electrotechnische Zeitung*, Proceedings of the Berlin University, Proceedings of München University, *The Electrical World*, *The Electrical Review*, *Electrician*, *Electrical Review*, of England, *Electric Engineering*, *Proceedings of R. S.*, *Proceedings of R. S. E.*, *La Lumiere Electrique*, *Philosophical Magazine*, of England, *Elektrotechnische Anzeiger*.

To show what kind of a course we have, I will give that of the physics course: First year—Last part of conic sections (Puckle and Todhunter); general physics (Deschannel, Daniel, Kohlrausch); laboratory practice; differential calculus (Williamson and Todhunter); theory of heat (Clausius and Maxwell); German language.

Second year—Integral calculus (Williamson and Todhunter); solid geometry (Frost); general physics and laboratory practice (experiments on heat and properties of matter); theory of light (Airy); German language; miscellaneous lectures on determinants, theory of numbers, etc.

Third year—Dynamics of a particle (Tait and Steele); statics (Todhunter and Minchin); physical laboratory (experiments on light, electricity and magnetism); theory of sound (Donkin and Helmholtz); mathematical theories of wave motions; invariants and coveriants; reading lesson with professor (as Thomson and Tait's natural philosophy); theory of functions, elliptic functions, quaternions, etc., etc.

Fourth year—Rigid dynamics, electricity and magnetism (Maxwell, Wiedemann, Chrystal's article in Encyclopedia Brittanica); miscellaneous reading and lectures; physical laboratory special investigation, mostly electricity and magnetism); astronomical observations and theory (Schauvenet; about 30 nights in clear weather); essays.

In the electric engineering department the student studies mathematics only to integral calculus. They have more practical lessons on resistance measurements, insulation testings, dynamo and motor construction, electric lighting both theoretically and practically, telegraphy and telephony, both theoretically and practically. The university owns several varieties of dynamos and lamps, and motors, with a 20 horse power engine, and a few gas engines. The students in electric engineering have usually five or six months of wholly practical work, during which they train themselves in practical workmanship.

They have a full equipment of instruments, including about two dozen galvanometers, among which are Thomson's double coil, high-resistance mirror galvanometer, potential galvanometer, ballistic galvanometer, ordinary and specially made, sine and tangent galvanometers, most of which came from England. They have about an equal number of resistance boxes, some of which were recently made by Elliot Brothers, and some high resistance 1,000 megohm boxes. They also have a few electrometers, including Thomson's quadrant electrometer, and a magnetometer made by Kew observatory, and another made in Japan after the new form invented by Assistant Professor Tanakadate.

MECHANICAL TELEPHONE.

Before closing this sketch of the Imperial University of Tokio, I will note the societies and journals we have, and meetings. All of them are conducted by the professors and students and graduates, with the exception of a few of the societies which admit outside members.

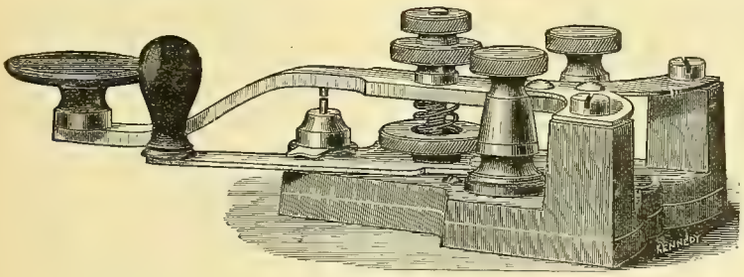
The name of the society, the stated time for meeting, and the time for issuing its journal, follow in order:

Law association, monthly, monthly.
Miners society, monthly, monthly.
Chemical society, monthly, monthly.
Engineering, civil and mechanical, monthly, monthly.
Literary association, monthly, no journal.
Philosophical society, monthly, monthly.
Physico-Mathematical society, monthly, four times a year.
Botanical society, monthly, monthly.
Zoological society, monthly, no journal.
Geological society, monthly, in two departments, one in English and the other in Japanese.
Anthropological society, monthly, monthly.
Seismological society, once in two months, once in two months.
Science association, once in two months, once in two months.

Most of these societies publish journals in the native language, and their membership varies from 20 to 300.

The leading scientific journals of Japan are the *Journal of the Medical College* and the *Science College Journal*. Both are published, under the supervision of a committee of the Imperial university in the English, German or French languages.

Besides these we have an alumni association of the graduates and a Sport club, which is equipped with everything in the line of base ball, tennis, boats, athletics, Japanese fencing and wrestling. They also own a large boathouse on the bank of Sumida river, where they have boat racing once a year.



NEW TELEGRAPH KEY.

New Telegraph Key and Mechanical Telephone.

A telegraph key made by A. B. Lyman, of Cleveland, O., and containing many obvious points of merit is shown on this page. The absence of trunnion screws will be noted at once. The lever made of fine wrought steel is firmly riveted to a phosphor-bronze spring support, which, in turn, is rigidly screwed to posts at the rear of the base on each side. This construction entirely does away with any side motion. The supporting spring which holds the key lever to the base has nothing to do with the tension of the lever, this adjustment being brought about by the spiral spring shown next the platinum point. This spring sets into a recess in the large checknut shown, which on being turned to the left increases the tension and to the right reduces the tension. The circuit-closer is so made that in opening or closing the circuit it can travel only the proper distance. The stroke of the lever is adjusted by means of the double checknuts seen on top of the key. The particular novelties claimed in the construction of this key are the construction of the key lever with the phosphor-bronze support and its attachment to the base, the manner of adjusting the spiral spring to suit the operator and the regulation of the stroke of the lever by means of the two checknuts.

From the method of construction of the key it is out of the question for the contact points to strike otherwise than squarely, inasmuch as there can be no side motion. It makes no difference how hard or heavy the operator sends, there is no jar, and consequently it is an easy key for fast sending.

Mr. Lyman has also just placed on the market the new mechanical telephone shown. It is exceedingly simple and, as might be inferred, inexpensive. It is mounted upon a finished base board three inches wide, six inches long and half an inch thick, with a hole in the center, to which is turned and fitted a convenient mouth piece which contains a diaphragm made of thin sheet steel with a common shoe button fitted in the center, to which is attached the line wire. Around the outer edge of the diaphragm is fitted a rubber band; the object of this is to allow free vibration of the diaphragm and at the same time prevent or deaden the ringing sound of the wire which is suspended in loops and stretched tight. The sound of the voice is reproduced at the other end of the line by the vibration caused by the speaker's voice on the diaphragm. Although these telephones are simple in construction the results are remarkable. Many of them are being used at a distance of one mile apart, although they are only recommended for from a few hundred yards to half a mile.

Collapse of a Tower.

A team of runaway horses collided with a brace to an electric light tower in Topeka, Kan., recently and so wrenched it that the tower collapsed and fell. Subsequent examination showed that one of the main supports had suffered badly from rust. No one was injured. A local paper gives this history of the tower: "The tower was erected in October, 1882, the purpose of the city fathers at that time being to illuminate the city with seven towers of that description, and a contract was made with the Elgin Tubular Iron tower company, of Elgin, Ill., to build the seven towers for $6,000. The company built the tower which fell over yesterday at a cost of $900, but it was scarcely completed before Mayor Wilson and his council found that the tower was not what the city wanted. In order to get the tower company to cancel its contract the city compromised on $2,945 for the one tower. After it had been in use a few weeks the light was shut off, and except during special occasions the tower has never since been in use. It has been a big elephant on the hands of the city. It was 150 feet in height.

It has been ascertained by many scientists who are not linemen, and many linemen who are not scientists, that the "light" wires are usually the heaviest ones.

Russell & Co.'s Automatic Engines.

The first automatic engines built by Russell & Co., of Massillon, O., were put on the market over three years ago, and were the result of much thought and study on the part of experts familiar with engine building. Meantime every improvement has been added in both design and construction that experience could suggest. The firm have constantly added to their list of sizes, making all engines of 11 inches bore and upwards of a much heavier type of bed than the smaller size, giving rise to two general classifications: the semi-girder type of bed, shown in Fig. 2, and the Porter type of bed, shown in Fig 4.

The semi-girder bed is of generous proportions and is designed to give the greatest amount of stiffness for a given weight of metal. The cylinder is made projecting, being free to expand while working.

The cylinder and chest are jacketed, the guides are bored, the cross-head has the pin in the center of its length and large brass shoes which are made adjustable. The connecting rod is of forged steel with solid ends and wedge adjustments. The boxes are of brass, lined with hard babbitt brought to size under hydraulic pressure. All the wearing parts are of the best steel, having extra large surfaces for wear. The fly wheel is of a diameter and weight proportionate to the size and speed of the engine. The valve used is known as Gidding's patent equilibrium slide valve, and is well worth the attention of engineers. It is shown in Fig. 1. It consists absolutely of one piece, a single casting, having the Allen double-ported feature and taking steam from underneath. The tendency to leave the seat is overcome by two needle-hole ports, the smaller of which admits steam to the back of the valve, while the larger one prevents the accumulation of a surplus pressure by permitting the escape of a certain portion of the steam into one of the exhaust cavities of the valve. The resultant pressure behind the valve, due to these two openings, is just sufficient to hold the valve up to its seat and insure a tight joint. The pressure back of the valve is usually 50 per cent. of boiler pressure, while the difference of pressure under and behind the valve is from 2½ to 3 pounds. The valve adjusts itself to wear, water and position. An experience of six years with upwards of one thousand valves in use, proves this valve to be one of the simplest, cheapest and best equilibrium slide valves known.

The Porter type of bed, shown in Fig. 4, is used on all sizes from 11 inches bore and upwards. The bed is very heavy, combining great stiffness with beauty of outline and symmetry of proportion. The cylinder and valve are of the same general design as those used in the other type of engine. The piston packing is designed with special reference to durability. The cross-head is of the locomotive type, having cross-gibs, the lower one running in a groove planed one-fourth inch deep in the bed, which serves to keep the oil on the wearing surfaces. The upper guides, as plainly shown in the cut, show a departure from the usual practice. Three large steel bolts to each guide are so placed as to resist the effect of angularity on the rod in the best possible manner. The rod is of forged steel with solid ends at crank and strap end of cross-head. The main shaft bearings are about once the bore in length and one-half the length in diameter, and the crank pin equals one-quarter the bore in diameter. The fly wheels are extra heavy on the largest sizes, and the outer bearings are provided with vertical adjustment, a feature peculiar to this engine, and which will be readily appreciated by all engineers.

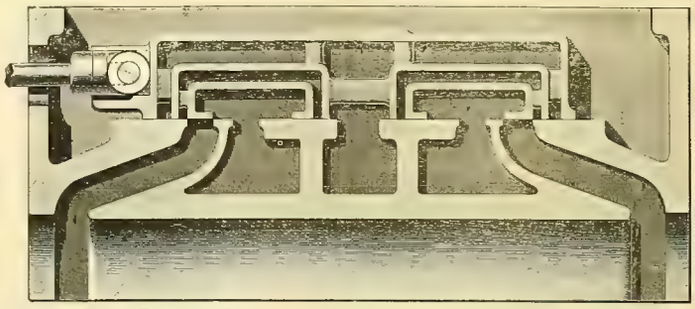


Fig. 1.—Russell & Co's Automatic Engine.

Another peculiar and distinctive feature of this engine is the patent governor, outlined in Fig. 3, which moves a single eccentric across the shaft, varying the travel of the valve to suit varying loads and boiler pressure. The lead is preserved practically constant for all points of cut-off, and the governor possesses the greatest degree of stability possible, being mechanically locked in every position it assumes. It is impossible to move the weights by pushing on the eccentric when the springs are out, consequently no dash pot or other device is necessary to prevent the sudden fluctuations due to pendulum action. At the same time the governor is extremely sensitive, instantly adjusting itself to great variations in loads without perceptible change. Many of these engines are working on 1 or 2 per cent. variation between extreme loads. The governor, by its peculiar construction, is one of the strongest in use, being fully capable of handling an unbalanced slide valve. All wearing surfaces are large, and means for taking up wear are provided. The large sizes of these engines are built with either single or double valves.

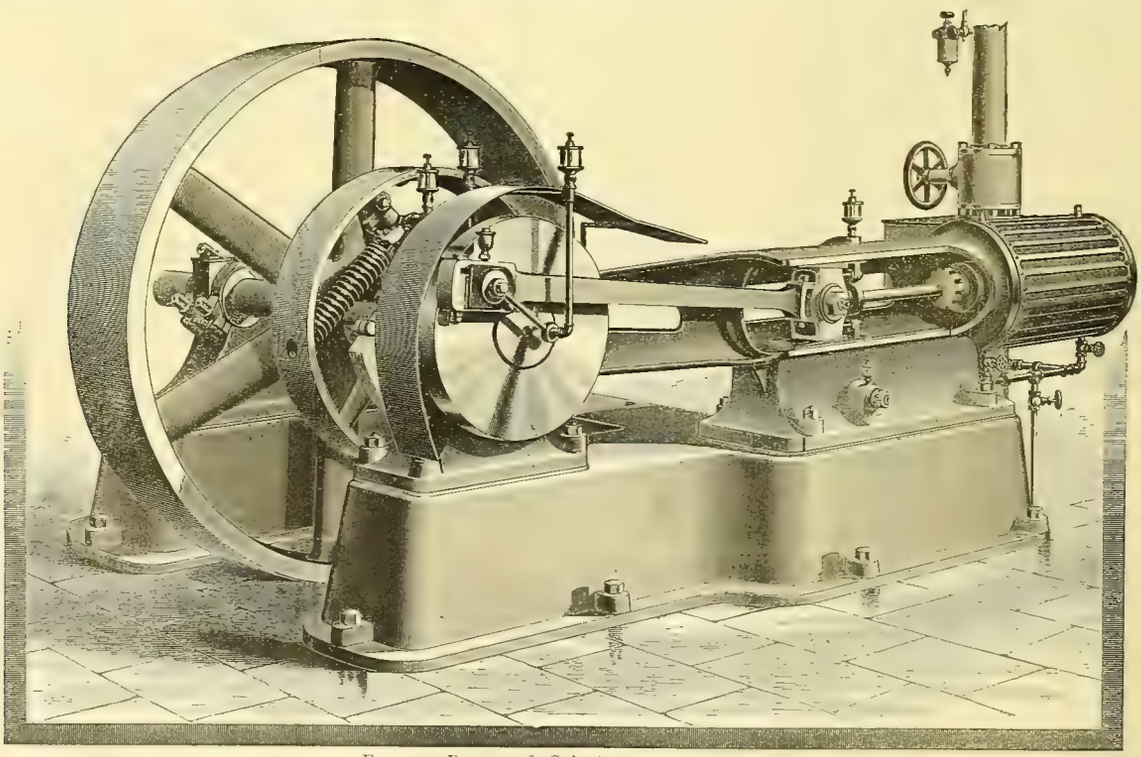


Fig. 2.—Russell & Co's Automatic Engine.

Edison's New Phonograph.

Said Thomas A. Edison to an interviewer regarding his new phonograph:

"You know that I finished the first phonograph more than ten years ago. It remained more or less a toy. The germ of something wonderful was perfectly distinct, but I tried the impossible with it, and when the electric light business assumed commercial importance I threw everything overboard for that. Nevertheless, the phonograph has been more or less constantly in my mind ever since, When resting from prolonged work upon the light, my brain would revert almost automatically to the old idea. Since the light has been finished I have taken up the phonograph, and after eight months of steady work have made it a commercial invention. My phonograph I expect to see in every business office. The first 500 will, I hope, be ready for operation about the end of January. Their operation is simplicity itself, and can not fail. The merchant or clerk who wishes to send a letter has only to set the machine in motion and to talk in his natural voice, and at the usual rate of speed into the receiver. When he has finished, the sheet, or 'phonogram', as I call it, is ready for putting into a little box made on purpose for the mails. We are making the sheets in three sizes—one for letters of from 800 to 0 words, another size for 2,000 words, another size for 4,000 words. I expect that arrangements may be made with the post office authorities enabling the phonogram boxes to b sent at the same rate as a letter.

"The receiver of a phonogram will put it int his apparatus and the message will be given ou more clearly, more distinctly than any telephon message ever sent. The tones of the voice i the two phonographs which I have finished ar

so perfectly rendered that one can distinguish between twenty different persons, each one of whom has said a few words. One tremendous advantage is that the letter may be repeated a thousand times if necessary. The phonogram does not wear out by use; moreover it may be filed away for a hundred years and be ready the instant it is needed. If a man dictates his will to the phonograph, there will be no disputing the authenticity of the document with those who knew the tones of his voice in life. The cost of making the phonogram will be scarcely more than the cost of ordinary letter-paper. The machine will read out the letter or message at the same speed with which it was dictated.

"I have experimented with a device for enabling printers to set type directly from the dictation of the phonograph, and think that it will work to a charm. It is so arranged that the printer, by touching a lever with his foot, allows five or ten words of the phonogram to be sounded; if he is not satisfied with the first hearing, he can make it repeat the same words over and over again until he has them in type. For busy men who dictate a great deal for the press I am sure the phonograph will be a necessity after a very little experience.

"For musicians the phonograph is going to do wonders, owing to the extreme cheapness with which I can duplicate phonograms and the delicacy with which the apparatus gives out all musical sounds. In the early phonograph of ten years ago, which was a very imperfect and crude affair compared to that of to-day, it was always noticed that musical sounds came out particularly well; the machine would whistle or sing far better than it would talk. This peculiarity of the phonograph remains. I have taken down the music of an orchestra, and the result is marvelous; each instrument can be perfectly distinguished, the strings are perfectly distinct, the violins from the 'cellos, and the wind instruments and the wood are perfectly heard, and even in the notes of a violin the over-tones are distinct to a delicate ear. It is going to work wonders for the benefit of music-lovers. A piece for any instrument, for a piano, or for an orchestra, or an act, or the whole of an opera, musical instruments and voices, can be given out of the phonograph with a beauty of tone and a distinctness past belief, and the duplicating apparatus for phonograms is so cheap an affair that the price of music for the phonograph will be scarcely worth considering. As the phonograph will be practically indestructible by ordinary use, such music can be played over and over again.

"My first phonograph, as you remember, consisted simply of a roller carrying the foil, and provided with a diaphragm-point properly arranged to scrape or indent the foil. The roller was turned by hand. In the new instrument there is far more complication, but altogether different results. My propelling machinery consists of a small electric motor run by a very few cells. Strange to say, I have found more difficulty in getting a motor to suit me than any other part of the apparatus. I tried various kinds of clock-work and spring motors, but found them untrustworthy and noisy. The motors I am now making are absolutely steady and noiseless. There is no part of the apparatus, the tools for which I am now making upon a large scale here, which is likely to get out of order or to work in an uncertain manner. The two finished phonographs are practically exactly what I intend to offer for sale within a few months."

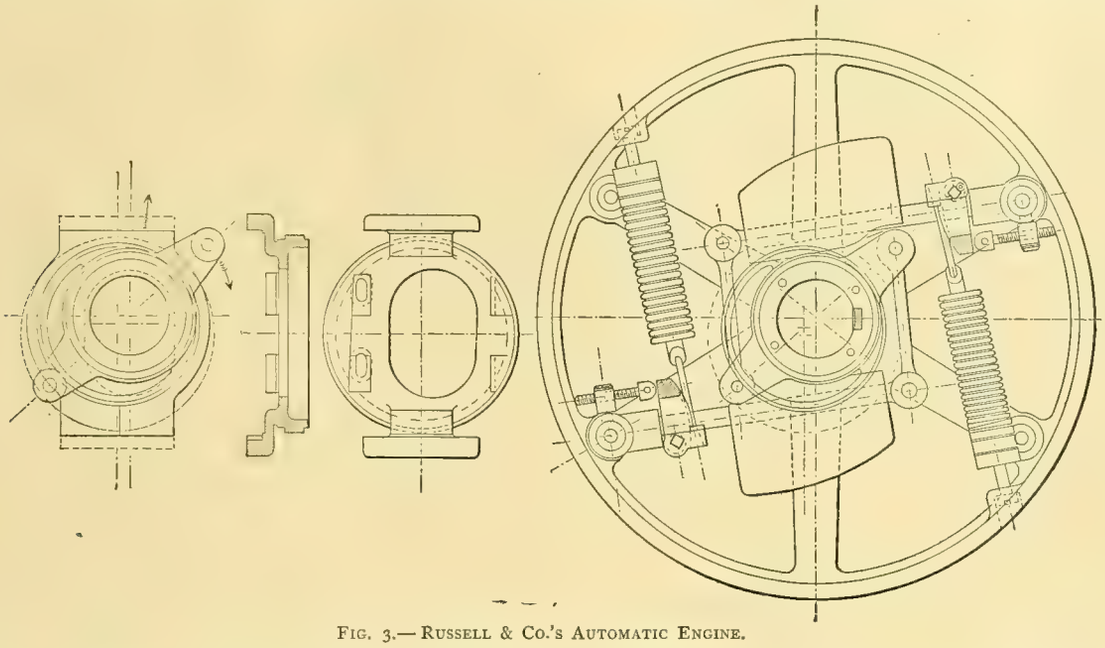


Fig. 3.—Russell & Co.'s Automatic Engine.

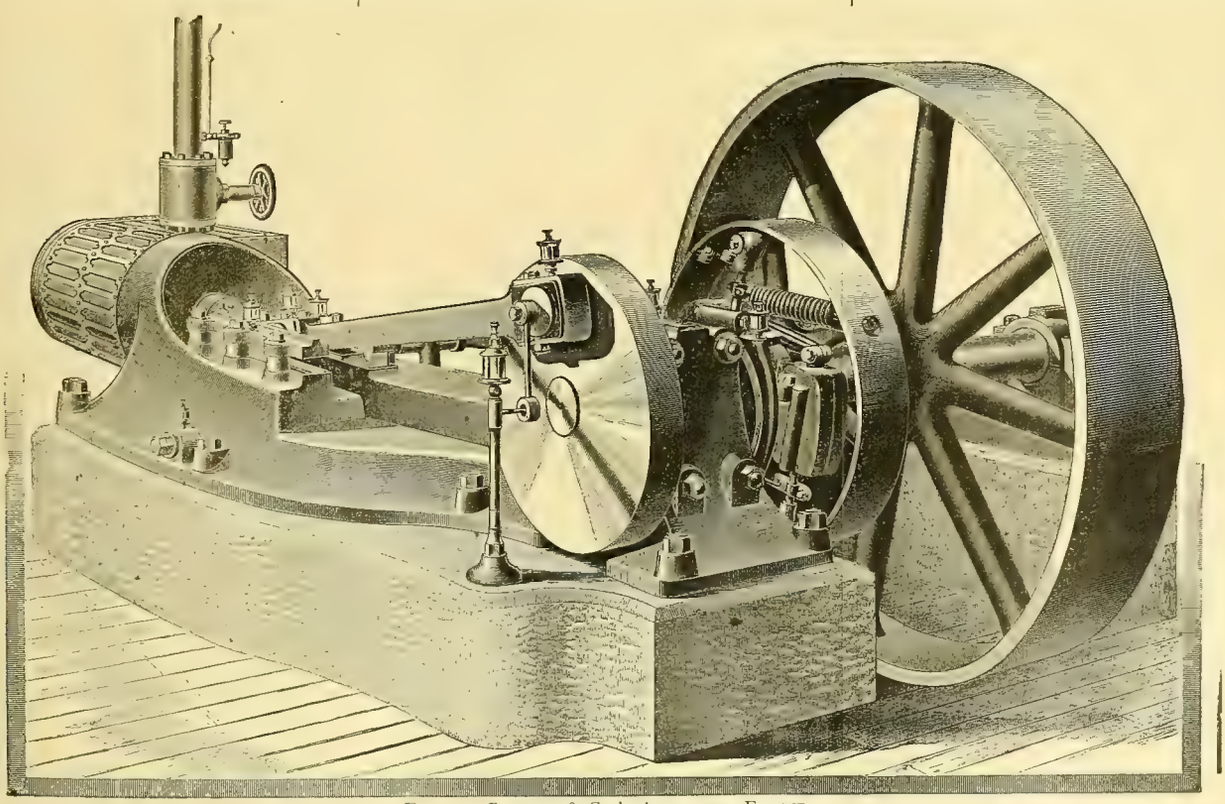


Fig. 4.—Russell & Co.'s Automatic Engine.

The Treadwell mines in Alaska are to be lighted by the arc light.

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AT last Monday night's meeting of the city council of Chicago, the committee on gas reported in favor of the passage of an order for an estimate of the cost of the city establishing its own gas works. The report elicited a lengthy discussion which was cut short by adjournment without any action being taken.

It is hardly possible that decisive steps will be taken toward establishing a city gas plant. The great complaint at present is that the illumination of the streets of the city by gas is very unsatisfactory and if the city owned its own gas plant it would be in no better position than at present, buying its gas from the various companies. On the other hand, the advocates of the electric lighting of the streets of the city are strong and numerous and the prospect is that gas on the the streets will be supplanted by electricity whether the city owns the plant or rents its lights.

MR. SAWAI's sketch of the Imperial University of Tokio, Japan, gives a very clear and comprehensive idea of the advancement of higher education in his country, both in the arts and sciences. He has devoted considerable space to the department of electrical engineering, and, as will be noted, shows that the institution is well equipped for theoretical and practical instruction in this branch of education. The scope and character of the work done by the institution is admirable, and as an exponent of thorough education in its highest branches, excites commendation and praise.

Mr. Sawai's visit to America, as stated last week, is to study the practical side of telephony. The use of the telephone in Japan is confined to private lines as distinguished from the exchange system. His particular study in this country is, therefore, devoted to exchange systems and the manufacture of exchange apparatus.

A UNITED STATES army engineer has lately constructed an enormous electro-magnet by winding twenty miles of submarine cable around two Rodman guns connected at the breech. Such is its magnetic strength that a bar of railroad iron thirty feet long can not be withdrawn by as many men as can grasp it. A 350 pound cannon ball, used as an armature, was made to vibrate between the opposite poles by a reversal of current, like the pith ball of an electric swing.

With hollow electro-magnet cores, there is the advantage of bringing the coils, through which the electric current circulates, closer to the enclosed armature than in the case of solid cores requiring the armature to be placed at the end. And since electric and magnetic intensity vary inversely as the square of the distance, it is easy to account for the superior magnetic intensity of the magnet above referred to. It will also be seen that if Professor Hughes' theory of magnetic shells is correct, hollow cores ought to have stronger magnetism in proportion to the mass of iron employed, than solid ones. This case is further exemplified in the peculiar construction of the field magnets of the Thomson-Houston dynamo, which nearly inclose the spheroidal armature; by which, it is claimed, the magnetic intensity of the field is concentrated on the armature.

ELECTRIC street railways receive strong indorsements in the letters published in another column. They are from the mayors of three cities in which such railways are in actual operation, and are unanimous in stating that electricity, as a motive power, is more desirable than horse power. Electric propulsion of street cars is, as yet, in its earlier stages. That it is successful in the places where it is in operation and where it has been subjected to the crucial test of time is abundantly proved; and that electricity will come into general use on street railways, is the realization of a not distant future. Electricians are naturally strong advocates of the electric motor, for they are thoroughly cognizant of its many points of superiority over any other method of propulsion, but after all, practice counts for more with the layman than theory, and when practice brings forth such testimony as is adduced in the published letters, electricians can congratulate themselves on one more step in advance.

THE recent death of the scientist Kirchhoff demands a brief notice of the life and labors of that eminent scholar. He was born in Kœnigsberg in March, 1824, and studied mathematics and physics in the German university; upon the completion of his studies he returned to Berlin, where he was accorded a public reception in 1848; he was appointed professor extraordinary at Breslau in 1850; some years later he was chosen to fill the vacant chair of physics at Heidelberg, which he occupied until 1870, the time of his nomination as professor ordinary at Berlin. He had been a corresponding member of the academy of Berlin since 1861, and was elected to the academy of sciences of Paris in 1870.

He is renowned for remarkable works and very careful researches in electricity, galvanism, elasticity, optics and the expansion of bodies; but his most important experiments were made with Bunsen upon the analysis of the spectrum, and the published results of these experiments have obtained for him a universal reputation in all countries where scientific studies receive attention.

WE are glad to welcome, as a contributor to our columns, Thos. D. Lockwood, who is well known as a writer of acknowledged ability on electrical subjects. We publish this week the first of a series of articles by him on the telephone, which is his specialty. It will be noticed that he takes radical ground in regard to the importance of a constant recurrence to first principles, and simple elementary instruction through the medium of electrical journals for the benefit of the constantly increasing class of learners in the various departments of electric work, and is not afraid that in so doing he lays himself open to the imputation of cracking electric chestnuts. In fact, as he suggests, if some of the older experts would occasionally take a few of these chestnuts as a relish it might improve their electric digestion, as well as that of the younger class.

The series of articles on the elements of electric lightning that we have been running since the inception of this journal, we are pleased to say have been warmly appreciated and commended. A similar series of articles on practical telephony, we believe, will be received with equal cordiality.

THE Rochester, N. Y., *Morning Herald* says of the bill prepared by the committee of the National Electric Light association, having in view the revision of the patent laws: "It has evidently been carefully drawn in the interest, not of the association named above or of any other combination or corporation, but of the people at large and, in view of the unsatisfactory condition of our patent laws and system, it would appear that congress ought to take the steps contemplated by the text of the proposed bill." And after an able review of the arguments supplementing the committee's work as shown in the bill, it continues: "Many other considerations are urged in behalf of the revision of the patent laws and a reorganization of the office, but we have said enough to show that there exists a feeling of profound discontent with the present condition of that department. The government can certainly afford to authorize and provide for the proposed commission, which shall take the whole question into consideration and submit its conclusions to congress for its approval and action. But it should, of course, be understood that whatever may be done in this matter shall have supreme regard for the public welfare. Every step of the progress made should be jealously watched by the press and by the representatives of the people that nothing may be embodied in the reconstructed system which would tend to foster more oppressive monopolies than those under which the public now suffers in many cases."

The purpose of the bill as shown in these columns heretofore is simply to create a commission to thoroughly examine the existing patent laws and patent office methods, and report to congress their revisions, recommendations and conclusions. The proposed bill is entirely conservative in character, and it seems to afford the best possible way for revising laws and methods which are admittedly very unsatisfactory.

IF Edison's new phonograph accomplishes all he is said to claim for it, and by the way, he is not given to idle vauntings, it will prove to be a most wonderful instrument. The first crude instrument, made ten years ago, was an astonishing production, but of no practical value—a mere scientific toy—and yet it demonstrated the possibility of giving speech or music a permanent form from which it could be reproduced by mechanical means whenever required. His new instrument accomplishes in a far more perfect manner all that the old one was capable of, and much more besides. Such is its extreme delicacy of distinctive utterance that the tones of voice of twenty different persons can be distinguished.

In the dead languages we have a striking illustration of the importance of the phonograph in preserving for future generations the actual language itself as spoken. No one now living has any conception of how Greek or Latin was originally pronounced, or whether the great Roman orator was called Sisero or Kikero, as the written characters, Cicero, give no indication of the sound; but the phonograph, were it then in use, would decide this at once; and not only so but would enable us to reproduce his finely rounded periods with all the impassioned eloquence which thrilled the Roman senate. So that purely as a means for historical record, the value of the phonograph cannot be overestimated. But, as its inventor claims, its practical value in business transactions will be of great importance, as in the identification of important legal documents, such as wills. Now we have, as a rule, only the signature, and the affidavits of the witnesses, which may be vitiated by forgery and perjury, but suppose the voice of the testator, with all its peculiar intonations as the will was dictated, could be reproduced and attested, forgery and perjury would be rendered nugatory.

But for musical reproduction, the phonograph must prove invaluable, if as Mr. Edison claims it can reproduce music more perfectly than speech. Now the composer can only roughly indicate, by written characters, the tones, chords and combinations which he wishes to have produced, while the subtile charm of the music itself, as given by his voice or his touch on the instrument, is utterly lost. What would we give to hear the actual music of Beethoven, Mendelssohn, or Handel?

With the phonograph and the telautograph added to the telephone and telegraph, the developments of the near future, in the record and transmission of speech, are full of promise. The voices of the past are hereafter to be born to us practically, and not alone in poetic fancy

Practical Telephony.

By Thos. D. Lockwood.

Part I.

Too frequently those who write text books, technical essays, or articles upon practical science, and particularly upon applied electricity, overlook the fact that the class to which many of their efforts are or should be directed is a constant one, that is, ever increasing in numbers. In other words, the electrical writer is apt to assume that inasmuch as other writers have ably and deftly wielded the instructive pen for the benefit of the student and learner, and have handled primary subjects in an easy and conversational way, so that the large and augmenting army of electrical neophytes find pleasure in acquiring a knowledge of the most interesting and engrossing study in the world's curriculum, or sometimes because he himself has in former times discussed subjects in a popular way, there is nothing left for him to do in that line, and that plain and clear expositions of familiar methods and apparatus may now be dispensed with, as being no longer necessary. And in consequence of these ideas, in the same way as the famous "populous minister" of Mrs. Malaprop, "dispensed with the gospel," the electrical writer dispenses with electrical lessons in plain English and easy words, assuming that all the students are now proficient; all the juniors grown up; all the young inspectors transformed into superintendents; and that the superintendents, and, in fact, all those concerned in the practical applications of electricity, have now become full-fledged electricians, and have reached the acme of erudition, where there is no more need of easy lessons, and where such lessons would be accounted as an insult only to be wiped out in blood. There are, however, several fallacies in this assumption. In the first place, allowing that those who were learning the rudiments three or four years since have now advanced and are fairly competent electricians, are there no successors to the race? It is not fair to those who are now treading in the path which we have traced, to leave them to their own devices. There will always be a far greater number of learners than of finished electrical experts, and it behooves us to remember that the large majority of them have neither money nor opportunity to procure or study electrical text-books, and that inasmuch as the weekly paper becomes their only resource, it is an absolute benefit to them to recapitulate the plain explanations of familiar things—familiar to us, but perhaps not so to all. In the second place, many of those who are now occupying prominent positions, have by no means such an extensive knowledge of practical electricity as they might have, and a little instruction given and received in a quiet way, does not come amiss to them. Then again, many have heard and read facts and explanations once, and in the press and hurry of business have forgotten them, and will always be glad to have them held up again, for it is in the majority of cases, only by "line upon line and precept upon precept" that information can be acquired and retained.

In pursuance of the foregoing reflections the writer has always kept in mind the young and rising generation of aspirants for electrical honors, and aims to discuss from time to time in the columns of the electrical press, in language as plain as that of Bret Harte's "Truthful James," a few of the most ordinary facts, ideas, and devices which present themselves. Moreover he feels empowered more particularly to so handle telephonic matters, inasmuch as such matters have more especially for the last seven years constituted his specific study.

Let us consider, for example, the regulation telephone outfit of the telephone exchange subscriber. We all know that in general terms, it comprises a polarized bell, and a magneto generator to send and receive calls, a transmitting and receiving telephone, a switch, operated automatically upon the removal or replacement of the receiving telephone to change the main line circuit from the bell magnet to the telephones and the reverse, a battery to energize the transmitting telephone, and a box to inclose and conceal the battery, the whole placed upon a suitable baseboard.

The automatic switch is also arranged to close the circuit of the transmitter battery, and thus bring the transmitter into action when the telephones are being used, and to open and maintain the same open when the telephones are not in use. A lightning arrester is usually fitted to the top of the bell box.

The entire outfit is perhaps one of the most compact and convenient, and yet efficient pieces of electro-mechanism ever put together, but how few, when they set it up, take any cognizance of the amount of thought it has taken to evolve it out of the mass of inventions relating to the subject.

Now there is nothing nicer and more inspiriting than a perfectly working telephone outfit, and this, together with a reasonably docile and intelligent subscriber and a faithful and painstaking central office operator, makes a telephonic communication a satisfactory operation.

However, when either of the three are in any way defective there is trouble, and worse than all, the trouble is uniformly laid to the credit of the telephone instruments. Therefore, it becomes an actual necessity, that when any complaint is made, relative to the efficiency of the instruments, the inspector or repairer should have an intelligent knowledge of his instruments, and the way they behave, both when in order and out of order, so that he can ascertain whether the faulty operation is due to the telephone instruments, the central office apparatus, the central office operator, the subscriber, or the circuit. It is possible for the trouble to be due to either one; to either two—or to all at once.

Whether from wilfulness, or from carelessness, it is certain that men do not often instruct one another, and thus when a new man is hired, he generally has both to instruct himself, and also to find out the true inwardness and the personal idiosyncrasies of his lines, subscribers and apparatus; for it is an absolute fact that no two are alike. I have no patience with the narrow-minded exclusiveness and jealousy, that would prevent one man from showing another anything about their common business, from the selfish fear that some day, the junior will pass over the head of the senior; and it is ten to one, that the man who is most afraid, will be the esiest to pass.

The Lightning Arrester:—Somewhere in, or on the bell box, we shall find what is popularly known as the lightning arrester. The name is not a very good one since it does not, even when it works, *arrest* the lightning. It might with more correctness be called a *discharger* or *diverter*, because when it works at all, it diverts the atmospheric electricity from the continuous road through the bell magnets, and tempts it to discharge from a series of points connected with the line, to a corresponding series connected with the ground wire; or per contra, it affords a chance for the electricity of the earth to discharge by the return stroke to line, and thence to the distant thunder cloud.

With the thinking person, even if he has had no experience, the question naturally arises, how can the lightning discharge, if it be electricity, get to the ground wire, since the latter is not in contact with the line, and why should it not continue through the bell coils? Simply this, and the said thinker will presently, if he keeps on thinking, arrive at the same idea himself, the kind of electricity which exhibits itself as lightning, has an electromotive force equal to a great many hundred thousand cells of battery, and shows it by jumping two or three miles through the air in such a spark as the celebrated induction coil of Mr. Spottiswoode in its most sanguine moments can never hope to give. It therefore finds no difficulty in jumping the small fraction of an inch presented by the distance between the lightning arrester points, and as a general thing will take that way, because it is a much shorter way to the earth, than the route through several hundred feet of insulated wire. The currents used in signaling and telephony, on the contrary are of comparatively low e. m. f., and have not much jumping power. They are consequently restricted to the longer but easier way through the coils.

The duty of the inspector with respect to lightning arresters, is as follows: In case of the form in which two sets of points, or points and plate, oppose one another, he must see that the points are screwed up as close as possible without actual contact so as to make the path to the earth as easy as possible. In case of that form of arrester in which two plates are separated by paraffined paper, he must see that the paper is thin but perfect. After a thunder storm, if trouble is reported, the lightning arrester in either case should be looked to at once; as when the plate form becomes operative, it does so by the action of the lightning in perforating the paper, to reach the ground plate, in which case a new piece of paper must of course be provided. When a piece of paraffined paper is so perforated, the edges of the hole made are usually carbonized, and a conducting film is thus made between the line and ground plates. In the other form the points sometimes are fused by the discharge. At every inspection it should be ascertained that the connection of the plate with the ground wire is a good one, and that the lightning arrester ground wire itself is large enough, and sufficiently well connected to the earth, at the waterpipe, gas pipe or elsewhere, to insure the lightning an easy route to the grave; a waterpipe being in all cases to be preferred.

So much for lightning—a word now for the electric light currents which by crosses are liable to burn out telephone apparatus. Lightning arresters as at present applied to bells provide no guard against such currents. Various devices have been invented to counteract trouble arising from these currents, some of which operate by a coarsely wound magnet to open the circuit; others in the same way ground the circuit; others again, also utilizing an electro magnet, merely shunt the office instruments, allowing the heating current to pass on to the next station. Another and radically different plan is to include a fusible link of some metal in the circuit on the line side of the instrument, or in a way station on both sides, so that if a dangerous current arrives, it will melt the link before it heats the apparatus to a dangerous point. This latter form, while possibly better adapted for use in central offices, does not appear to me to be as well suited for a subscriber's station as is an electro-magnetic tripping device to open the circuit; and the electro-magnet need not necessarily constitute an obstacle to conversation, as it may be placed just outside of the bell magnet, and arranged to be cut out, when the telephone is removed from the switch support. Any one making an examination of this device should, if the said device be electro-magnetic, be careful to see that the contacts are clean, and the binding screws tight; and if the metal foil fusible protectors be employed, it is also essential to look well to the contacts, and to closely examine the foil, for it usually has a very deceiving surface and looks all right, while it really has no conductivity at all. These protectors should be rejected if they show the slightest flaw.

(*To be continued.*)

Answers to Electrical Problems.

To the Editor of Western Electrician.

In continuance of the answers to the electrical problems propounded in number 4 of the Western Electrician:

Problem 2 represents a line with ground connections at both ends, three condensers in series, a battery of 100 volts, and a rheostat of 100 ohms between the battery and first condenser.

Queries: 1. Will inserting the resistance in this position reduce the potential of the charge when the condenser is fully charged? 2. Or will the potential be the same as if the resistance had not been there?

Answers: 1. The potential is represented positively by the energy stored up on the battery side of the condenser or condensers, and negatively by the energy repelled by induction from the ground side. The element of time is not taken into account. Hence, while the condensers would charge more slowly with the interposed resistance present, its insertion can not reduce the amount of potential; and hence: 2. The potential will be the same as if the resistance had not been there.

Problem 3 represents a line with connections similar to the last, a battery of the same capacity, two condensers of one farad each, and a 100 ohm rheostat placed between them. It is assumed by the author of the problems, that the potential on the battery side of the first condenser

is +100, and on the ground side of the second condenser —100, since the e. m. f. of the battery is 100 volts; that there is no current through the condensers, but that there is a current on the line between them through the rheostat.

Queries: 1. Is the rate of flow between the condensers governed by the difference of potential (+100, —100=200) or by the e. m. f. of the battery, 100? In the former case the author assumes that it is two ampères; and in the latter one ampère. 2. Is the current driven by electric attraction and repulsion at the condensers, or does it flow in consequence of the difference of potential between the positive side of the first and the negative side of the second, as in ordinary circuits? 3. Has the current the e. m. f. of the battery, or that due to the difference of potential in the condensers? i. e., is it a 100 volt or a 200 volt current?

Answers: 1. The potential on the negative side of the first condenser is exactly equal to that on the positive or battery side, and is consequently 100 volts, this produces a current through the 100 ohms resistance of the rheostat to the second condenser, which must therefore equal one ampère. 2 and 3. The voltage can not by any arrangement of the condensers be made to rise higher than its source, the generator, as otherwise the reaction would produce a counter current.

PROBLEM 4 represents a similar line and battery; four condensers of one farad each, and four rheostats of 100 ohms each, one between each two condensers, and one between the last condenser and ground.

Queries: 1. Is the rate of flow one ampère or two ampères? 2. Does the battery overcome the total resistance of 400 ohms? 3. Or does it simply charge the first condenser; the current then overcoming the 100 ohms by virtue of the difference of potential thereby established, thus charging the second condenser, which sends a current through the next 100 ohms, and so on, repeating this action through the series. 4. If the resistance between the first and second condensers was made 200 ohms, would the rate of flow through the series be governed by:

$$\frac{\text{Difference of potential}}{\text{Highest R in any section.}} = \frac{200}{200} = 1 \text{ ampère? Or, } \frac{200}{500} = \frac{2}{5} \text{ ampère?}$$

Answers: 1. The current must flow through the whole line if it flows at all, and hence must encounter the whole resistance, 400 ohms; as the negative potential at the ground side of the condenser must exactly equal the positive at the battery side; hence $\frac{100 \text{ volts}}{400 \text{ ohms}} = \frac{1}{4}$ ampère. 2 and 3. The battery is the only source of e. m. f, and hence must overcome the total resistance. A condenser while acquiring positive potential on the battery side is acquiring negative potential on the ground side up to the full measure of its capacity, a gradual process, electricity being repelled to earth at the ground side as it accumulates on the battery side. 4. If the first resistance were increased to 200 ohms it would simply add 100 ohms to the total resistance, and the formula would be $\frac{100 \text{ volts}}{500 \text{ ohms}} = \frac{1}{5}$ ampère. ZETA.

Electric Street Railways Indorsed.

A copy of the appended letter, dated at Elizabeth, N. J., was sent by N. C. J. English, chairman of the committee noted, to the mayors of Scranton, Pa., Montgomery, Ala., and Lima, O.

"A street railway, using the Van Depoele system of electric motors, has applied to our city council for permission to use the public streets for running passenger cars. The application has been referred to a committee of the common council for investigation, with directions to report. We are informed that the Van Depoele system is in use in your city. Will you, therefore, kindly give us answers to the following inquiries?

"First—Is the electric system of running street cars as used in your city generally approved by, or is it objectionable to the citizens?

"Secondly—How does this system of running street cars compare with horse power in speed and the comfort and general accommodation to the public?

"Thirdly—Does the electric system of poles and wires work any injury to the property owners along the route?

"Fourthly—Is it considered any more dangerous to the public travel along the street than the horse car system, or as much so?

"Fifthly—What is your opinion, if you will be so kind as to give it, as to the desirability of substituting electric power for horse power for propelling street cars?

Mayor Ezra H. Ripple, of Scranton, replied:

"First—The electric system of running street cars is very generally approved by our citizens.

"Secondly—In comparison with horse cars as to speed, comfort and general accommodation to the public, it is capable of more than double the speed; it can not be excelled for comfort and furnishes every accommodation that can be desired.

"Thirdly—I have not heard of any injury to property owners along the streets by the poles and wires beyond killing a few trees, but very few, and there is a question whether this was due to the wires of the railway or to the electric light wires.

"Fourthly—It is not considered any more dangerous to the public travel along the streets than the horse car system, if kept within the same rate of speed that horse cars run. At first horses were a little afraid of it, but are rapidly becoming used to it, and very few show any fear now.

"Fifthly—In my opinion there would be every advantage gained in substituting electric power for horse power."

W. S. Reese, mayor of Montgomery, Ala., replied:

"First—The electric system of running street cars is generally approved by our citizens.

"Secondly—The speed is considerably greater than by horse power, and the comfort and accommodation are satisfactory to the public.

"Thirdly—The poles and wires have worked no injury to property owners along the line.

"Fourthly—Thus far the danger has not proven greater than by horse power.

"Fifthly—I regard electricity, as a motive power, more desirable than horse power, at least so far as my limited experience extends; but I can not say if it will work well during the winter in a climate subject to much snow and ice."

Mayor William McComb, Jr., of Lima, O., wrote in reply:

"First—It is generally approved by our citizens.

"Secondly—It is far superior to horse power.

"Thirdly—The poles and wires work no injury to property owners along the route.

"Fourthly—I do not think it as dangerous as the horse car system.

"Fifthly—I think, and almost every person who sees it in operation thinks, that it is the finest system now in operation anywhere. Our people here are highly pleased, and I am sure your folks will be when they see it in operation."

Magnetism in Time-pieces.

E. Sordet, director of the horological school of Geneva, Switzerland, writes to a jewelers journal: Watches are magnetized in hundreds of ways of which no man knows; approaching a dynamo or a small magnet of any form, such as a horseshoe magnet, or magnets in the telephone receivers or transmitters are all fatal to watches. Electric motors, such as used on street railways, are particularly destructive to time-pieces, and the general introduction of electric motors in large cities must be followed by the adoption of non-magnetic watches. Putting a magnetized knife in the pocket alongside of a watch is fatal, and handling the balance spring or parts of the escapement with a pair of magnetized tweezers produces magnetism to such an extent as to destroy the accurate rate of the watch. Ladies' steel corset-springs become magnetized and ruin their watches, and severe electrical storms magnetize the hair-springs and destroy numbers of watches.

If the balance and hair-spring of a watch are non-magnetic, I have found that saturating the watch with magnetism has no deleterious effect.

Again, if the escapement as well as balance and spring is made of non-magnetic metals, the watch may be placed on the poles of the most powerful dynamo without stopping it or producing any evil effect. With a steel escapement and non-magnetic balance and spring, placing the watch between the poles of very strong magnets so that the magnetic current passes directly though the escapement causes the watch to stop, but by moving the watch so that the escapement is not in the direct current, the watch immediately resumes its rate.

My experiments with the Paillard non-magnetic watch have proved conclusively that it overcomes all the difficulties arising from magnetism in watches.

Paris & Scott's Continuous Current Transformer.

The continuous current transformer of Paris & Scott, at the Newcastle exhibition, is now employed in lighting the model dwelling, and receives the current from the engine room through 900 yards of number 12 copper wire. As the number of lamps in the villa is considerably below the capacity of the transformer, 64 lamps, besides some resistance, have been also placed in the circuit. The transformer is a two-pole machine, and two sets of coils are wound on the armature, the commutator for the primary coils being at one end of the shaft, that for the secondary at the other end. The primary coils contain four times as many turns of wire as the secondary, but of rather less than one-quarter of the sectional area, so that the resistance of the primary wire is twenty times that of the secondary, and under normal conditions of working nearly the same amount of energy is absorbed in each. The field magnet coils form a shunt to the secondary circuit, and the primary current is not employed in exciting the field. This causes the machine to hesitate before starting, and sometimes to start in the wrong direction. To obviate this, Paris & Scott propose to place a few turns of the primary wire upon the field magnets. This will secure prompt starting in the proper direction, but will not sensibly interfere with the behavior of the machine when fairly at work. The two sets of brushes for the primary and secondary currents respectively being independent, they may be set at any angle. Suppose the primary brushes to be set so as to make the machine run at the best advantage as a motor, then it is clear that if the secondary brushes were turned so as to be at right angles to the primary brushes, a big current might be sent through the secondary coils and the field magnet coils, also excited from some external source, without offering any resistance to the rotation of the armature, and without any e. m. f. being produced by the rotation between the brushes of the secondary coil. Without going so far as this we may turn the secondary brushes into such a position that with a small resistance in the secondary circuit, the e. m. f. in that circuit may be small, but the current very large—in fact, much more than four times the current in the primary coils—and yet the primary current may be quite capable of driving the machine at a high speed. Of course the product of the primary current and the e. m. f. between primary terminals—that is, the watts *in*—must exceed the product of the secondary current and the e. m. f. between its terminals, or the watts *out*, by an amount equivalent to the heat generated in both the armature coils and in the field magnet, and the work required to overcome the mechanical resistance to the motion; but this is quite consistent with the current in the secondary circuit very much exceeding four times that in the primary, provided the e. m. f. be correspondingly reduced. In a test of the efficiency of the machine which has just been made the current in the secondary circuit was exactly four times that in the primary, the one being 42 ampères, the other 10.5 ampères. A voltmeter was employed having a resistance of 2,336 ohms. This was connected directly to the secondary circuit, and registered 74 volts. To the primary circuit it was connected through a resistance of 7,008 ohms, so that the same indication of the voltmeter corresponded to four times as many volts. This enabled the two readings to be taken in nearly the same part of the scale, and any error in the instrument was made of little importance. The voltmeter thus arranged registered 86 volts, corresponding to an actual e. m. f. of 344 volts. This represents a *commercial* efficiency of 86 per cent., the ampère meter

employed in measuring the secondary current being inserted in the external circuit so as not to measure the exciting current of the field magnets. By exerting considerable pressure on the brushes by hand the mechanical friction was very much increased, and the primary current was increased by an ampère, while the secondary current showed no change.

It will probably be very easy to control the brushes of the primary or secondary circuit automatically so as to keep the e. m. f. in the secondary circuit constant, whatever variations may take place in the e. m. f. of the primary. By shifting the primary brushes it was found possible to raise the e. m. f. of the secondary circuit until it was exactly one-quarter of that of the primary. When the e. m. f. of the secondary circuit was then raised, the whole output of the machine was necessarily increased, as no change was made in the number of lamps; but this was effected at the expense of efficiency, for the current in the primary circuit was increased in a greater ratio. In fact, when the e. m. f. of the secondary was thus raised to a maximum a considerable amount of sparking took place at the primary brushes, and the best position of the brushes to avoid sparking was found to be that which made the current in the secondary just four times that in the primary, so that there was just the same number of ampères turns in each circuit. In one experiment when the speed of the engine had been reduced so that the e. m. f. of the primary was only 304 volts the brushes were set back until the e. m. f. in the secondary circuit was 76 volts. The current in the secondary was then 38 ampères, that in the primary 12¼ amperes, showing an efficiency of only 78 per cent., instead of 86 per cent. as above. When the brushes were placed so that the e. m. f. in the secondary was 63, and that in the primary 272 volts, the currents were respectively 38 and 10.25 ampères, showing an efficiency of nearly 86 per cent. The highest efficiency obtained in any experiment was 87½ per cent., when the currents were respectively 42 and 10.5 ampères, giving the same number of ampère turns in each circuit, and the volts were respectively 70 and 320; but this figure is probably a little in excess.

The high tension or primary coils on the armature have a resistance of 1.45 ohms, the low tension coils about .07 ohm. The field-magnet coils forming a shunt to the secondary circuit have a resistance of 49.2 ohms. If we take the case mentioned above, where the currents were respectively 42 and 10.5 ampères and the e. m. f. 74 and 344 volts, we have:

Watts absorbed in primary	3,612
Watts obtained in secondary	3,108
Watts wasted in heating primary coils	160
Watts absorbed in field magnet coils	111
Watts absorbed in heating secondary armature coils	132

Leaving a deficiency of only 110 watts for driving the machine. There is thus a loss of 4.4 per cent. in the primary armature coils, 3 per cent. in the field magnet coils, and 3.66 per cent. in the secondary armature coils, while rather less than 3 per cent. of the energy received is employed in doing the mechanical work of driving the armature against friction. The current in the secondary armature coils is of course that in the outer circuit, together with the exciting current. It is clear, from the above figures, that there is practically no loss by Foucault currents.

It was found that when the secondary brushes were turned through a considerable angle a great amount of sparking was produced, so that measurements have not yet been made with the primary brushes in their best position to drive the machine as a motor, and the secondary brushes turned through an angle so as to considerably reduce the e. m. f. on the secondary current.—*London Electrician.*

Dry Pile.

Shelford Bidwell, says *Electricité* has constructed a voltaic element in which the electrolyte is peroxide of lead. The plates are of lead and sodium, between which is placed the peroxide of lead, carefully dried. A current, comparatively strong, passes from the sodium to the lead.

CORRESPONDENCE.

New York Notes.

NOVEMBER 12.—As the members of the American Institute of Electrical Engineers and the New York Electrical society reached the exhibition hall last Wednesday, Nov. 9th, to attend the joint meeting called for that evening, they were met with the startling news that a shocking accident had just occurred which had resulted in the instant death of one of their associates. The cards of invitation which were sent to members and their friends stated that the tickets of admission would admit at any hour prior to the meeting, so that members might also inspect the electrical exhibition then in progress. It was in taking advantage of this invitation that Sidney F. Shelbourne met his awful death. He arrived at the institute building shortly after the opening of the doors at 7 p. m. and went immediately to that department known as Machinery hall, where he obtained permission to enter an inclosure in which a Ball and a Trenton engine were in operation in connection with dynamos supplying arc and incandescent lights, Robert Ashton being the engineer in charge. While passing the fly wheel of the Trenton engine, a wheel 80 inches in diameter and making at the time about 200 revolutions a minute, he fell against it, was dragged under it and then thrown up against a beam overhead, his mangled body falling upon the cylinder of the Ball engine. Mr. Shelbourne was lame, his right leg being shorter than the other, necessitating the use of an iron lift under the foot, and, as he fell to the right, it is supposed that the iron foot slipped and he was thus caught by the wheel. Fortunately at that early hour but few visitors had arrived and none saw the horrible sight. The remains were immediately cared for and all traces of the accident obliterated. Mr. Shelbourne was 51 years of age and was unmarried. He was a graduate of Yale college and by profession a lawyer, but he was widely known as an electrician, his name frequently appearing before the public in connection with the affairs of the New York Electric Lines Co., of which he was president. During the last few years of his life he gave his attention especially to underground cable matters, in which field he made a number of valuable inventions, and at the time of his death he was in litigation about the rights of his company to tear up the streets of New York for the purpose of laying electric wires. He was a regular attendant at the meetings of the American Institute, and will be sadly missed.

The Edgerton Electric Motor Co. of Philadelphia expect to open an office in New York soon. They are meeting with great success in the sale of their slow speed motors, and promise to put upon the market soon a new and improved electric fan.

The special committee appointed by the assembly last winter to investigate the standing, methods, charges and expenses of the telephone companies of the State, began their work in New York City on the morning of the 10th at 21 Cortlandt street. The testimony of officers of the Staten Island, Westchester and New York and Pennsylvania telephone companies has been taken and recorded, and the work will be continued next week, when the affairs of the Metropolitan Telephone company will be looked into. The Staten Island company has 272 subscribers, at rates varying from $60 to $120. The capital stock is $125,000, $45,000 of which was paid to the Metropolitan company for franchise. Treasurer Clark said that the percentage of earnings on the cost of the plant for the 16 months ending in 1884 was 4.57; for 1885, 4.87, and for 1886, 5.14. The Westchester Telephone company also held a franchise from the Metropolitan Telephone company for which they paid $100,000. They have 1,006 subscribers at rates varying from $60 to $100. The gross earnings to July last were $184,290.70, expenses, $133,123.18, net earnings $51,167.52, on which dividends of $6,000 each have been declared, one in 1883 and the other in 1886. The average net earnings a year were 3.4 per cent. on the capital. The testimony reported as follows is particularly interesting, because this investigation is really aimed at the American Bell Telephone company, and Mr. Storke is one of the most prominent telephone officers in the country:

"Chairman Ainsworth took up the question of royalties, and asked the witness, H. L. Storke, to give his opinion upon the royalties paid by the various companies in which Mr. Storke was an officer to the Bell Telephone company; also as to the stock which these companies were compelled to issue for their franchises.

"Mr. Storke—I know that it is too heavy a burden on the business of the local companies. We can't afford to pay it.

"As to the relative merits of the flat rates and the toll system of charges, Mr. Storke thought the toll system the only absolutely fair and equitable one. All other charges were arbitrary The toll system would increase the price to large users and diminish it for small ones. It would also add to the income of the company. The system would not be practicable in the Westchester district, however, without an installation rate to cover the cost of the telephone.

"Mr. Storke made this interesting observation: 'I think from 25 to 33 per cent. of our business is dead-head.'

"Q.—How so? A.—Why, for instance, every grocer's customers use his 'phone. They take it as a matter of course, and the grocer dare not refuse.'

"Mr. Storke's attention was next called to the dates of the expiration of some of the Bell Telephone company's patents. He believed that the precise time was March, 1893.

"Q.—What, after that date, do you think will be the future of the telephone business? A.—I believe there will be a surprising development and when it comes it will compel us to expend a large amount of money to meet the increase in business. The patent on the receiver only then expires.

"Q.—Does not the Bell company own several hundred patents? A.—I believe so.

"Q.—So the same service could not be rendered in 1893 as now? A.—No. But a service could be rendered which we can not give now. We could then do more business at less rates.

"Q.—Would any change be effected in the amount of stock you have given for your franchise? A.—No. The only change to come to us would be in taking off royalty charges.

"Q.—What per cent. in royalties have you already paid? A.—I can't tell exactly—more than our net earnings, though.

"Q.—Is there anything in your contract providing for a diminution of royalty at a certain time? A.—No.

"Q.—The contract is a perpetual one? A.—Yes. But there would be an equity there to control the matter.

"Mr. Saxon broke in here with the calm remark: 'There may be an equity, but I think the contract would control.'" A.

From Germany.

BERLIN, Germany, Nov. 1.—The electric light installation in the Royal opera house has been finished. There are 3,870 incandescent lamps, of from 16 to 50 candle power, and 3 arc lamps, with a total of 90,400 candle power. Of this, 56,268 candle power is used on the stage. In the first entrance is the apparatus for regulating the strength of the light on the stage and in the auditorium. In order to get light effects of different colors the bunch lights, ground rows, foot and border lights are provided with three sets of lamps, namely, of clear, green and red glass. The lamps of the same color are combined in one circuit. By moving a switch either the clear glass, green, or red lights can be connected with the regulating device mentioned above. There is no need of gas anywhere. In the dressing rooms even the water and the irons used by the tonsorial artists are heated by electricity. The current is generated at the central station, 44 Markgrafenstrasse, and conducted to the theater by means of eight cables of a total cross-section of 4,800 square millimeters, equal to about 90 number 0 wires, B. and S. gauge. The Aron meter is used for registering the amount of electrical energy.

The city council decided September 29th to light the handsomest street of Berlin, Unter den Linden, by electricity. On the 20th of September, 1826, gas for the first time illu-

minated this street in place of oil. The Berlin newspapers at that time spoke in ecstasy of the "new, brilliant light which made the Linden brighter than daylight" Maybe sixty years hence our grandchildren will smile at our present "brilliant illumination." The Linden will be illuminated with 104 arc lamps from the Branderburger Thor to Spandauer street, a distance of little over a mile. Sixteen lamps will be hung over the center roadway; 42 lamps on each side of the street and 4 lamps over the Kaiser Wilhelm bridge. The lamps will be about 28 feet above the level of the street. Only 44 lamps will burn after midnight till sunrise. The cost for lamps, wiring and candelabra is estimated at $20,500, the running expenses per year $25,000. The price per lamp hour is fixed at 9 cents. B.

Indianapolis Items.

INDIANAPOLIS, Nov. 12.—The police commissioners have decided to establish a patrol box system here and to that end have advertised for bids for building and putting the boxes in place. The boxes are to be of octagon shape and each supplied with a telephone connected with the police station.

At a meeting held this evening it was found that over $410,000 of the $500,000 needed by the Consumer's Gas Trust company to begin operations had been subscribed. Additional canvassers announced their willingness to take hold, and it is the intention to hustle things the coming week to secure the necessary amount. The present indications are that there will be some lively competition in natural gas business. The Indianapolis company have signified their intention to come in and do business under ordinance rates; they with the Capital City company, Broad Ripple company, and Consumer's Trust, which is bound to succeed, will make fuel plenty and cheap. The Indianapolis company, whose wells are at Noblesville, twenty miles north, have already begun to lay their mains, and to-day contracted for building a telephone line along the route of their mains with the intention of putting in a station at each valve. The idea is to have watchmen patrol the line, when completed, and report by telephone to the wells and main office in this city whenever a break or leak is discovered.

The telephone company last week put up two eighty feet poles on Illinois street, where their lines cross the Union railway tracks, to clear the new train sheds.

George W. Bender, who commenced as a telegraph operator, on the Cincinnati, Indianapolis, St. Louis & Chicago railroad some sixteen years ago, has just been appointed general superintendent of the road. He held the position of superintendent of telegraph for some time, and during the past two years has been superintendent of the Indianapolis, Decatur & Springfield railroad, in which position he has been succeeded by L. A. Boyd, formerly superintendent of telegraph on the same road. M.

Milwaukee Mention.

MILWAUKEE, Wis., Nov. 12.—Last night E. P. Allis & Co. started their new Edison plant. The capacity of the plant is 750 lights; in the new offices there are 500 lights, in the pattern shop 180 lights and in the engine room 70 lights. They also have in use a 50-arc light American plant. The company expects to put in another 750 light Edison plant. Jacob Cloos is the electrician.

The Northwestern Insurance company building has about 1,200 incandescent lights burning The plant consists of three Edison dynamos, the two larger of which are run by a Corliss engine with friction clutch pulleys, and the smaller by an independent Armington & Sims engine.

At the insane asylum there are two small Edison dynamos with a capacity of about 450 lights.

There is considerable wiring being done in Milwaukee on the Edison three-wire system.

L. A. Carr, formerly with the Edison company, is going to Jamestown, D.T., next week to install a Brush arc and Edison incandescent plant. He will be accompanied by Harry Stuckey.

An electric railway of the Van Depoele system, six miles in length running between the city and the insane asylum, is projected.

The Badger Electric Illuminating company is now burning about 200 arc lights of the Thomson-Houston system Their total capacity is probably between 450 and 500 lights. They have all the work they can do. The company has about three miles of underground wire.

The exposition building contains three 20-light Van Depoele machines which are run to their full capacity; a 300-light Edison plant and a 10-light United States arc dynamo.

The car works of the Chicago, Milwaukee & St. Paul railroad at Merrill park are lighted by 500 Edison incandescent lights; in the foundry and car wheel works there is a 10-light United States plant. C.

Detroit's Budget.

DETROIT, Nov. 12.—The Telephone & Telegraph Construction company is making another addition to its underground system, using 6,000 feet of water log. Into this conduit will be drawn 125, 75 and 50 conductor cables of the Standard Underground company's pattern.

The Sturgis Electric Light company, capital stock $12,000, was organized on the 8th inst. The stockholders and directors are: H. L. Anthony, E. T. Parker, H. A. Clapp, F. W. Wait, W. C. Grobisher, F. B. Ainger. The company will start out with six hundred lights and expect to be in running order by December 1st.

The Marquette city council having quashed the franchise of the Edison company on account of failure to comply with the requirements of the same; new bids for the city lighting are in order.

The American Bell Telephone company has began suit against the following, agents of the Cushman Telephone company: Edmund Ely, Davisburg; Eugene L. Langworthy, Linden; Albert T. Parish, Byron; Lawson E. Becker *et al*, Fenton; Albert W. Prescott, Holly. C.

THE ELECTRIC LIGHT.

Work on the Coffeyville, Kan., electric light plant is rapidly progressing.

The franchise of the Monmouth, Ill., Illuminating company is for twenty years. Work will be pushed forward without delay.

Snyder & Tiernan, of Fort Scott, Kan., propose to put in the Thomson-Houston electric light system at Rich Hill, Mo.

The Trinidad, Colo., Electric Light company has been organized with $25,000 capital.

The Edison company at St. Paul, Minn., is putting in two two hundred horse power Root boilers and otherwise increasing its capacity. At present the company is furnishing 7,500 lights.

The poles and wires for the electric light plant at El Dorado, Kan., are up and lights will be burning shortly.

The plant at Council Grove, Kan., consists of one forty horse power automatic engine; one arc dynamo of 38-arc light capacity; twenty-four arc lamps of 1,200 candle power each; twenty star incandescent lamps of 65 candle power each; four groups of incandescent lamps, of sixteen candle power, five lamps to each group; three miles of number 6 underwriters wire. The water works company will furnish the housing for machinery and power, and operate the plant under contract with the city.

The Larned, Kan., Electric Light company are preparing to put in another boiler of eighty horse power, and a fifty light arc dynamo.

The electric light plant at Stockton, Kan., is to be doubled in capacity.

Here is a specimen of the manner in which a Kansas paper welcomes the electric light, the reference in the excerpt being to the plant at Lyons: "The electric light company have leased a strip of land in the city park, just north of the old Bedford blacksmith shop, 80 feet front and 140 deep, upon which to erect a building for their machinery. The lease expires in twenty-one years. The building for the dynamo is to be of wood, substantial, and an ornament to that part of the city, and the engine room to be of brick. Everything will be built to stay. Hurrah for the electric lights!"

The palace of the emperor at Tokio, Japan, is lighted by 3,000 Edison incandescent lights, and there are three central stations in operation in the city of Tokio. Outside of the imperial city there are several isolated plants.

The new electric light plant at Racine, Wis., is in operation.

THE ELECTRIC MOTOR.

The machinery in George G. Allen's foundry in Nevada City is to be run by electricity for a week or two, in order to give mining men an opportunity of being convinced that such power can successfully be utilized as motive power, and at one-half the cost of steam.

The Electric Light & Power company of Washington, Kan., has been incorporated with a capital of $12,000. Besides furnishing light for the city, it will furnish power for running the machinery of factories that will soon be erected.

The street railroad company of St. Cloud, Minn., contemplates putting in the Sprague system to run their cars. The power in all probability will be water power.

An elevated road between St. Paul and Minneapolis, Minn., has been projected and a company formed. It is the intention to propel the cars by electricity.

The St. Catherines electric railway using the VanDepoele system is to have its equipment increased by four motors of fifteen horse power each.

The Chattanooga & Suburban street railway company of Chattanooga, Tenn., is to run its cars by the electric motor or the VanDepoele system. Ten motors have been ordered.

It was announced that the Enos overhead electric road on the South Park Elevated road, running from South Park to St. Paul, Minn., would be tested this week.

A contract has been made to put in an electric plant for pumping in the Paradise Valley mine, Wild Rose district, Nevada, says *Mining* and *Scientific Press*. The company has water power at the mill, but this power must be conveyed six miles distant to the mine where the pump is to be run. The pump is four hundred feet underground. A 15 horse power dynamo will be used to furnish the electricity, and a 10 horse power motor will be used at the mine. Mr. Keith, the electrical engineer, estimates that two horse power will be lost in transmission in this distance, and three horse power in conversion. There would be no more loss in transmitting 40 horse power. In this case there is very little power to be carried. The expense of conductors is as much as for the rest of the plant. There has been some question as to the best method of gearing down from the high speed of an electric motor to the slow speed of a mining pump. Belts and ordinary gearing do not well serve the purpose, but worm gearing does. Since electricity has come into vogue as a power there has been great improvement made in worm gearing, as there has also been in steam engines for driving dynamos. It is now made on more scientific principles than formerly, and experiments prove that it is equally efficient with belts for transmitting power, while much better adapted for this special purpose.

The electric locomotives have now been in regular use for about three months, running alternately with the horse cars, and performing the journey of four and a half miles in forty minutes, says *Industries*, describing a visit of inspection of the electric road of the Elieson company between Stratford and Manor Park. The weight of the locomotive is about 6½ tons, and that of the loaded tram car may be taken as 5 tons, making a total rolling load of 11½ tons. The road is in a fairly good condition and almost level. We were informed by Mr. Elieson that he found the traction — as measured by a dynamometer — to vary over the whole line between 22 pounds and 26 pounds per ton. Taking 24 pounds as the average, this would give 276 pounds of tractive force required for the propulsion of a rolling load of 11½ tons. Each locomotive, after having made a double journey, is run into the shed, and the charge of its batteries is replenished from dynamos in an adjoining room. The charging

plant consists of a portable engine working, by means of a countershaft, three dynamos, one a Crompton machine for 200 volts and 100 amperes, and two Phœnix dynamos each for 200 volts and 50 amperes. In the dynamo room there is a switch board so arranged that any of the machines can be used to charge any of the cars in the shed, and the charging current is regulated by varying the e. m. f. by me ns of rheostats placed in the shunt circuit of each machine. The charging of each locomotive lasts forty minutes, and five minutes are allowed for running the locomotive in, coupling up, and running it out again on to the line. We learn from a record compiled by the company that during the months of August and September the weekly average of journeys per car drawn by their locomotives was about 130, and the daily average of passengers carried per car varied between 685 and 872. The daily average of passengers carried by an ordinary tram car is given as 475, showing that the electric cars were patronized to an unusual extent, probably owing to the novelty of the system. The time during which the electric locomotives have been in use is of course too short to determine accurately the all important question as to the cost of electric traction; but making liberal allowance for interest on the capital outlay, wages, fuel, oil, water, waste, depreciation, and repairs, Mr. Elieson estimates the cost at 4½d. per car mile.

THE TELEPHONE.

An ordinance has been passed by the city council at St. Cloud, Minn., compelling all electric light, telegraph and telephone companies in the city to use one set of poles.

A joke is told in the Omaha *Bee* of a Dallas young man who overrated the powers of the telephone. He had an engagement to take his sweetheart to a sociable, but happening to meet with an accident on the way to her house, he went to a near telephone to explain why he could not fill his engagement. Going to the instrument he called the inevitable—"Hello!" "Hello again!" came in the softest accents. "Is that you, Miss Eula?" "Yes." "Well, I've met with a serious accident and can't come." "Oh, DeWitt! what is it? Are you hurt much?" with pitying accents. "No, not hurt at all; but——" "Then why can't you come, if you are not hurt? What is the matter? Please tell me," with great anxiety and curiosity. "Oh, it ain't much. I'll tell you some of these days." "No, I want to know now; I'll be mad if you don't tell me. What is it? Tell me right off." "Well, if you must know, I've torn my best pants from the Rio Grande to Red river. Just look here," and he raised his coat and turned toward the telephone amid a roar of laughter from the few who were gathered around. He thought in his excitement that his inquisitive friend could see through the telephone. They haven't met since.

THE TELEGRAPH.

There will be a new telegraph line built from Anderson to Igo, Cal, shortly.

Within twenty-four hours recently the thermometer fell from summer weather to some degrees below zero centigrade in Silesia. A single night's snowfall put an end to the telegraphic communication. Wreaths, some inches deep, hung from the poles and wires, and in many places the wires were broken and poles overturned by the fierce winds accompanying the snow.

Announcement is made that the French cable company has secured concessions for laying a cable or a series of cables from Charleston to Cuba, Hayti, Martinique and South America. There is one cable between Florida and Havana, controlled by the Western Union, which does a good business — when it is not out of order. A cable was once laid to Aspinwall, but it has not been working for a long time.

M. Coulon, the director-general of posts and telegraphs in France, has summoned a commission of the higher officers of the establishment to consider among other matters the following questions: The employment of the system called steno-telegraph, by which messages are transmitted by stenographic signs; the introduction of multiplex telegraphy; the use of the electric light in telegraph offices.

The telegraph was introduced in Japan about fifteen years ago, and now the islands are well strung with wires and connected with each other by cables. The operators are wholly native born and in order to keep up the supply and meet the wants of the future, a school has been established for the instructions of operators, not only in the manipulation of the instruments, but also in the line of education in branches of study that would be the equivalent of those pursued in the typical high school of America.

A dispatch from Montreal says that the Western Union company is greatly dissatisfied with the earnings of the Great Northwestern company, composed of the Dominion and Montreal companies, to both of which it guarantees a dividend of 8 per cent. since the Canadian Pacific company has been in the field, and is anxious to terminate as speedily as possible its agreement with the former company and enter into a working partnership with the Canadian Pacific, dividing the profits equally. If this were carried out it would leave the great Northwestern company with the Montreal and Dominion franchises on its hands, and all hopes of a profitable business gone. The Canadian Pacific lines do not tap all the important centers that the older corporation touches, but it is in contemplation to extend the lines as quickly as possible so as to compete with the Western Union in every way possible.

Charles Moore, a telegraph operator employed at Huntington in the train dispatcher's office of the Chicago & Atlantic railway, at the time the terrible wreck occurred at Kouts, has become insane. Moore resigned his position several days ago. He said his heart failed him every time he entered the office, and recalled the scenes enacted therein while the officials were receiving news of the killing and cremation of their passengers. On the day following the wreck, Moore states that a number of officials of the road met in the dispatcher's office at Huntington. They, with telegraph operators and train-men, wept in each other's arms as the horrible news came in. The chief dispatcher sickened of reporting each hour additional deaths and horrors and called Moore to the key. The young man stated the above facts before he became insane.

The opinion of the supreme court in the case of the Great Western Telegraph company against Gray, given at Springfield Nov. 9th, says a press dispatch, is a very important one in the interest of the creditors of the company and as affecting the 2,000 stockholders. The decision reverses the judgment of the appellate court of the second district and the circuit court of Lake county. It decides that the assessment of the circuit court of Cook county in Terwilliger against the Great Western Telegraph company, made in July, 1886, upon the stockholders for 35 per cent. is valid and binding, and gives a good cause of action; that the contract of subscription makes the stockholder liable to pay the par value of the shares subscribed for; that the statute of limitations is no defense to an action on the assessment; that in the chancery case of Terwilliger vs. the Great Western Telegraph company the power of the circuit court to make the assessment was not affected by the fact that the stockholders in person were not before the court when the assessment was made; that it was sufficient that the corporation was then before the court; and further, that the law of 1872 concerning corporations has no effect upon this corporation, or any proceedings relating to it. It also decides that the opinions of the court in the cases of Chandler vs. Brown, 77 Ill., 333, and Lamar Insurance company vs. Gulick, 102 Ill., 41, are not authority in any cases except when the proceedings are under the twenty-fifth section of the corporation act of 1872. In this case against Gray, the defendant had paid 40 per cent. of the par value of his subscription, and claimed that such payment discharged his liability, but the court holds him liable for the other 60 per cent., if necessary to pay the debts of the company. The decision covers all the points ever supposed to have been available as defenses.

Miscellaneous Notes.

The city council of Merrill, Wis., has taken the preliminary steps looking to the organization of a fire department.

Paradoxical as it may seem, the latest thing for which dynamite has been employed is not the blowing up of buildings, but on the contrary, the laying of their foundations. This new development is due to M. Bonnetond, a French engineer. When a foundation has to be laid in wet ground, he bores a hole from ten to twelve feet deep and an inch and a half wide. Into this hole he passes a string of dynamite cartridges, which are then exploded. Not only is a cavity of a yard wide produced by the explosion, but the expansive force of the dynamite drives the water out far beyond the sides of this cavity, and it does not return again for more than half an hour. In the meantime the workmen clear the cavity and introduce quickly-setting concrete, so that when the water returns again it can not injure the foundation. The method has been put into practice during the building of an *enceinte* at Lyons, and a rapid rate of working is said to have been attained thereby.

A fire department has been organized at Corunna, Mich.

During the month of October $73,332.31 was paid out of the fire department fund of Chicago.

The oil lamps used on railway passenger trains in France, writes a tourist, are removable, and are made to a standard size. There is an opening in the roof to receive them, and before a train starts on its trip a man will be seen walking along the roofs, taking out the lamps, passing them down to a man on the platform, and replacing them by others that are filled. They are also lighted and manipulated from the roof, and though they may leak and smoke the passengers can do nothing with them. It therefore frequently happens that a lamp will leak until the glass beneath the burner is covered with oil, and the flame will be smoking until the light of the car becomes so dim that the passengers can scarcely distinguish each other.

At a recent meeting of the Kansas City council, an ordinance was introduced to grant L. H. Holmes a franchise to erect wires along certain streets and alleys, to be used in running electrical clocks and other timepieces operated by electricity. Mr. Holmes explained the scheme as follows: "It is intended to have a central station at 718 Main street. At our central station we have a regulator, which will be very accurate, it being compared daily with signals which come daily from the observatory at Glasgow, Mo. A dial is furnished to each customer. This dial is a regular clock front, but instead of clock-works the space is occupied by a magnet. By a simple system of electrical circuits any number of dials are connected with this regulator, and with the batteries at the central station, which furnishes the motive power. All these connections will be made with carefully insulated copper wire, with house top circuits, so no poles will be used. These clocks, or dials, will be furnished to the customers at a certain rental. The system which works the clocks is that on the sixtieth second of each minute the regulator closes the circuit with the batteries, causing the pointers on each one of the dials to advance one minute."

Prof. P. G. Tait, of Edinburgh, succeeded, some years ago, in locating a fragment of iron in the hand of a person by means of a magnetic needle lightly suspended, and more recently W. Preece has performed an experiment of a similar nature. The daughter of Mr. Preece had thrust a needle into her hand by accident. The needle was broken into three pieces, two of which they had been able to extract, while it was impossible to find the third. The induction balance of Professor Hughes indicated its presence properly, but without giving the position. Mr. Preece having strongly magnetized a very fine needle, suspended it with a light iron by means of a buckle inclosed in paper, and a single fiber of silk. On approaching the injured hand, the deviations of the needle indicated always the same place, which was marked with ink; an incision in this place discovered the third piece, about four mm. long, which was easily extracted.

Johnny Norton well-known years ago as the "electric boy" of Bunnell museum fame has unfolded the secret of his success, says he: "That was one of the best 'fakes' of the time, and there was lots of money in it, too. When I was on exhibition I was inclosed in an oblong stall about seven or eight feet long, the front of which was like a narrow counter. Opposite the counter was a rail which only allowed the visitors to pass in single file. A long strip of cocoa matting served as a carpet for the passageway, and also as a cover for a sheet of zinc which extended beneath it, running the length of the stall. My box was similarly invested with zinc and matting. Attached to the sheets of metal, but hidden from view, were the two poles of a galvanic battery, one under my feet and the other in the passage. Now any one passing over the zinc and touching me, behind the counter, completed the circuit and received a shock. So did I. The matting, of course, had to be kept damp, water being the conductor. It was surprising what intelligent people were duped by this trick. Why, I was kept shaking hands and being fingered from morning until night. Many's the $2 note I received from doctors and others for a couple of drops of my blood for analysis. In fact my arms were covered with scars made by scientific dupes boring for my electric gore. One evening three or four young students came in to unmask me. One of them made a wager that he would electrify the audience the same way if he was in the box. I immediately invited him in and he accepted the challenge. I then retired, but before doing so I pressed a hidden button that cut off my wire. He, of course, failed, and ignominiously retreated after being guyed unmercifully by those present. This proved me genuine to the satisfaction of every one in that town and I became famous. There was lots of fun in the business, but I had to give it up as the constant strain caused by the battery was too much for me."

J. E. White of Syracuse, N. Y. has devised a mercurial fire alarm in which the wires penetrate the top of the tube. When the mercury is expanded by heat it rises in the tube and, as it were, forms a metallic bridge between the wires when it reaches them.

Personal Paragraphs.

S. A. Croser, president of the Edison Electric Light & Power company of St. Paul, has recently returned from a European trip.

Carl Hering, a well-known electrician and writer upon electrical matters has been appointed a member of the committee on science and the arts of the Franklin institute at Philadelphia, Pa.

General O. E. Madden, of Boston, who was assistant general manager for a long time of the American Bell Telephone company, is now engaged in various electrical enterprises, and also in promoting a hot water heating company at the Hub.

Business Mention.

The Western Electric company, of Chicago, have closed a contract for forty city lights at Champaign, Ill., and another forty-light plant at Valparaiso, Ind.

The Railway Telegraph Supply company, M. A. Knapp, manager, of 211 Randolph street, Chicago, is furnishing the Mound City Messenger company, of St. Louis, 500 American district call boxes and the full equipment for putting them in use.

The Standard Underground Cable company, through F. E. Degenhardt western manager, have sold the Chicago Arc Light and Power company within sixty days 78,000 feet of No. 6, B. & S. electric light cable for underground work; the Brush Electric Light company at Sault Ste. Marie 500 feet of submarine armored cable in which the armoring wires are embedded in marine jute; the Telephone and Telegraph Construction company at Detroit 2,000 feet of 125-conductor, and 1,970 feet of 75-conductor, No. 18, B. & S. cable for underground work; the Chicago Telephone company 750 feet of 100 and 150 wire cable for underground purposes.

The Ashtabula Water Works Co., of Ashtabula, Ohio, will add electric light to their water works business. They have commenced by ordering sixty lights from the American Electric Manufacturing Co., which they expect to increase considerably.

Within thirty days the Railway Telegraph Supply company, M. A. Knapp, manager, of Chicago, has turned out over 200 annunciators of all sizes.

The Van Depoele Electric Manufacturing company, of Chicago, has sold the Consumers Electric Light company, of Chicago, a 60 light plant. The new station of the lighting company will be on Blue Island avenue.

So far this year the Thomson-Houston Electric company has installed, or has orders on its books for installing, central stations to the number of 130.

The Northwestern Construction company, of St. Paul, Minn., are doing an active business. They have equipped or have under construction, six central station plants. One of the most recent is that for the St. Cloud, Minn., Gas Light company, burning 60 arc lights and 2,000 incandescent lights. The latter are of the Westinghouse alternating system, and the arcs are of the Thomson-Houston system.

The Woodbury Engine company, of Rochester, N. Y., have issue a unique and handsome catalogue, devoted exclusively to their new self-contained high speed automatic cut-off engine. The details are made very clear by well-executed cuts. The statement that the catalogue is devoted exclusively to their new automatic engine should be slightly modified. The front cover shows the D. A. Woodbury engine of 1850. The points of difference between the engine of well-nigh two score years ago and that of to-day are exceedingly interesting, and the idea of a pictorial comparison between the engine of 1850 and that of 1887 was a happy one.

Russell & Co., of Massillon, O., made the following sales during October: Russell & Co., Portland, Oregon, one 9 in. x 14 in. engine with 48 in. x 14 ft. boiler, one 10 in. x 16 in. engine with 52 in. x 14 ft. boiler; Tacoma Electric Light & Water Co., Tacoma, W. T., one 10 in. x 16 in. engine with two 54 in. x 12 ft. boilers; M. Swope, Merrill, Wis., for a saw mill, one 12 in. x 18 in. engine with one 60 in. x 16 ft. boiler; Mathias Braun, Wausau, Wis., for saw mill, one 9 in. x 14 in. engine with one 54 in. x 12 ft. boiler; T. R. Wall & Co., Clintonville, Wis., for saw mill, one 9 in. x 14 in. engine with one 48 in. x 14 ft. boiler; Minnesota State normal school, Owatonna, Minn., one 7 in. x 12 in. engine; William Turner, Hunting, Wis., for saw mill, one 9 in. x 14 in. engine; Reeves Iron Works, Canal Dover, O., one 20 in. x 27 in. engine; Louisville, Ky., Coffin works, one 14 in. x 20 in. engine; Water Works, Minneapolis, Kans., one 10 in. x 16 in. engine; Brush Electric Light Co., Louisville, Ky., one 10 in. x 16 in. engine; for an electric light plant at Kingman, Kans., one 10 in. x 16 in. engine, with one 54 in. x 12 ft. boiler; Studebaker Bros. Mfg. Co., South Bend, Ind., one 15 in. x 20 in. engine, with one 66 in. x 16 ft. boiler; for an electric light plant at Peru, Ill., one 10 in. x 16 in. engine; Hartford, Conn., Hammer Co., one 10 in. x 14 in. engine; J. H. McLain, Canton, O., one 13 in. x 20 in. engine, with one 66 in. x 16 ft. boiler.

Electrical Patents.

Issued Nov. 8, 1887.

372,657. Electrical Repeating Bell. Harry B. Cox, Cincinnati, Ohio.

372,658. Galvanic Battery. Harry B. Cox, Cincinnati, Ohio.

372,720. Process of making Electric Gold Pictures. Argyle W. Tucker and Elihu M. Tucker, Mansfield, Texas.

372,734. Carbon Battery. Charles H. Wilder, Boston, Mass.

372,797. Electrcial Distribution. John W. Howell, New Brunswick, N.J.

372,798. Electrical Distribution. John W. Howell, New Brunswick, N.J.

372,799. Electrical Distribution. John W. Howell, New Brunswick, N.J.

372,805. Telegraphic Transmitter. George Juengst, Croton Falls, N. Y.

372,808. Electro-Therapeutic Apparatus. Frederick J. Kneuper, New York, N.Y.

372,822. Dynamo Electric Machine. Frank J. Sprague, New York, N.Y.

The armature core is wound with, first, a cylinder coil, then two ring coils on opposite parts of the core, then another cylinder coil, and so on, all the coils being connected into a continuous series and said series being joined to separate commutator bars between each cylinder coil and the adjacent pairs of ring coils.

372,823. Electric Motor. Frank J. Sprague, New York, N.Y.

372,824. Electric Pumping Apparatus. Frank J. Sprague, New York, N.Y.

372,846. Telegraphic Transmitter. W. Warrington Evans, Washington, D.C.

372,851. Electrical Current Indicator. John F. Kelly, Hoboken, N. J.

372,860. Resistance Regulator for Electric Currents. George Montanus, Frankfort-on-the Maine, Germany.

372,865. Railway Signal. Frederick Pearce, New York, N.Y.

372,910. Electric Motor. Daniel Higham, Philadelphia, Pa.

The field magnet pole pieces are slit or laminated on lines radiating from the center of the axis and transversely to the direction of rotation of the armature.

372,934. Method of and Apparatus for Connecting Alternate Current Generators. Oliver B Shallenberger, Rochester, Pa.

372,935. Apparatus for Connecting Alternate Current Generators. Oliver B. Shallenberger, Rochester, Pa.

372,936. Pressure Indicating Apparatus and Circuit for a System of Electric Distribution. Oliver B. Shallenberger, Rochester, Pa.

372,940. Insulating Joint. Francis H. Soden and Henry Goehst, Chicago, Ill.

The joint is designed especially for suspending electric arc lamps.

372,942. System of Electrical Regulation. William Stanley, jr., Pittsburg, Pa.

372,943. System of Electrical Distribution and Conversion. William Stanley, jr., Great Barrington, Mass.

372,944. Method of Electrical Distribution and Conversion, William Stanley, jr., Great Barrington, Mass.

The method consists "in generating currents, converting the same into currents of different potential, translating the last named currents into energy of a different form, varying the resistance encountered by the last named currents inversely as the resistance encountered in converting the currents into currents of different potential is varied, and varying the resistance encountered in conversion directly as the resistance encountered in translating the last named currents into another form of energy is varied."

372,945. Dynamo Electric Machine. William Stanley, jr., Great Barrington, Mass.

372,958. Electric Firing Mechanism for Guns and Shells. William W. Bradley and James R. Holroyd, Washington, D. C.

372,986. Regulator for Electric Lamps. Sylvain Mathis, Morlanwelz, Belgium.

373,009. System of Electrical Distribution. Henry M. Byllesby, Roselle, N. J.

373,010. Electric Meter. Henry M. Byllesby, Pittsburg, Pa.

373,021. Galvanic Battery. John W. Howell, New Brunswick, N. J.

373,029. Electrical Converter. Oliver B. Shallenberger, Rochester Pa.

The invention is designed to prevent accidental discharge of electricity between the primary and secondary coils.

373,034. Dynamo Electric Machinery. Henry E. Walter, Clifton, N. Y.

The inventor states before the claim: "It will be seen that the means employed in my invention and their operation are the same with simple motors and converters; * * and I wish it to be understood that, under the expression 'electro-dynamic motor' in the claims, I include both simple motors and rotating double wound converters, and under the expression 'armature circuit,' I mean either the simple armature circuit of a motor or the primary or motor circuit of the double wound rotating converter."

There are nine claims, the first of which is, "The combinations with a shunt wound dynamic motor, of an adjustable resistance in the armature circuit thereof, inside the terminal of the field shunt, and a switch acting automatically upon the starting of the motor to gradually cut out such resistance."

373,035. System of Electrical Distribution. George Westinghouse, jr., Pittsburg, Pa.

The invention relates to an organization of circuits, and apparatus designed to be employed for the purpose of storing up energy to provide against an emergency, as, for instance, the interruption of the supply circuit connections.

373,036. Automatic Circuit Controlling Apparatus for Systems of Electrical Distribution. George Westinghouse, jr., Pittsburg, Pa.

The apparatus is intended for interchanging the connections of the electric circuits employed for supplying the translating devices, so that in case of accidental interruption of one line the apparatus normally connected therewith will be automatically placed in connection with another line.

373,037. System of Electrical Distribution. George Westinghouse, jr., Pittsburg, Pa.

The design of the invention is to secure a constant or approximately constant difference of potential at the terminals of different groups of translating devices connected in the circuit.

373,038. Converter Box. George Westinghouse, jr., and Henry M. Byllesby, Pittsburg; Oliver B. Shallenberger, Rochester, and Albert Schmid, Allegheny, Pa.

The converter box is constructed in two sections, one section being secured at the top and bottom to supports, and the other having two separate compartments for receiving the primary and secondary circuit-controlling devices.

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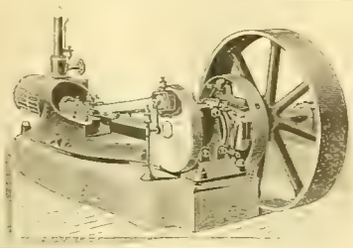

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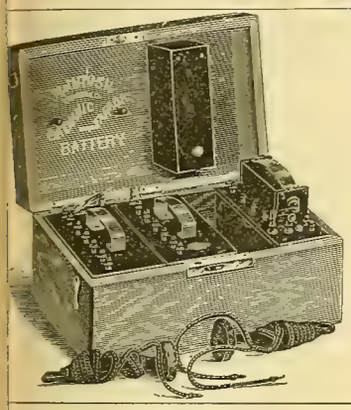

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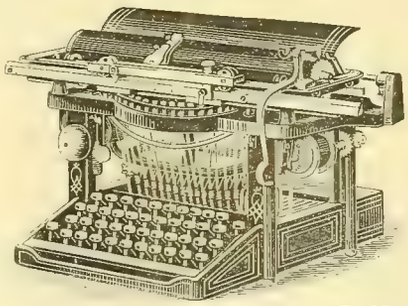

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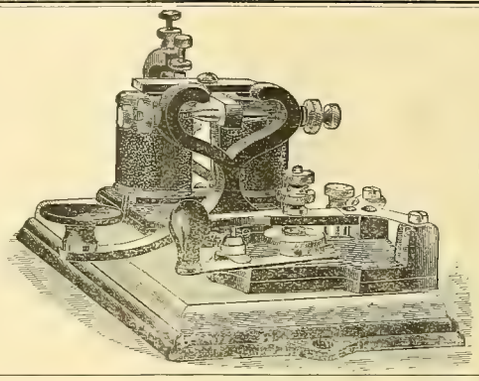

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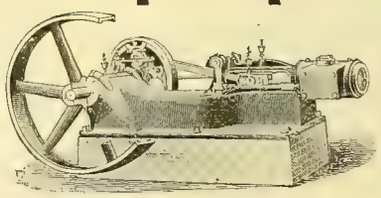

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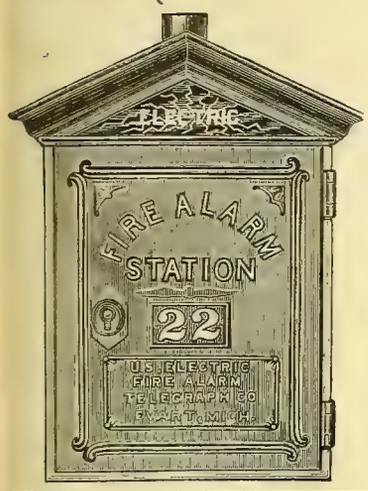

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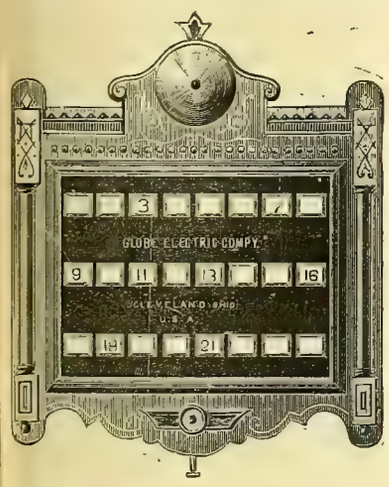

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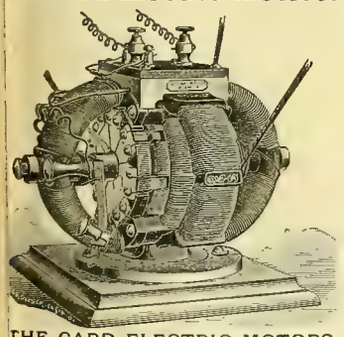

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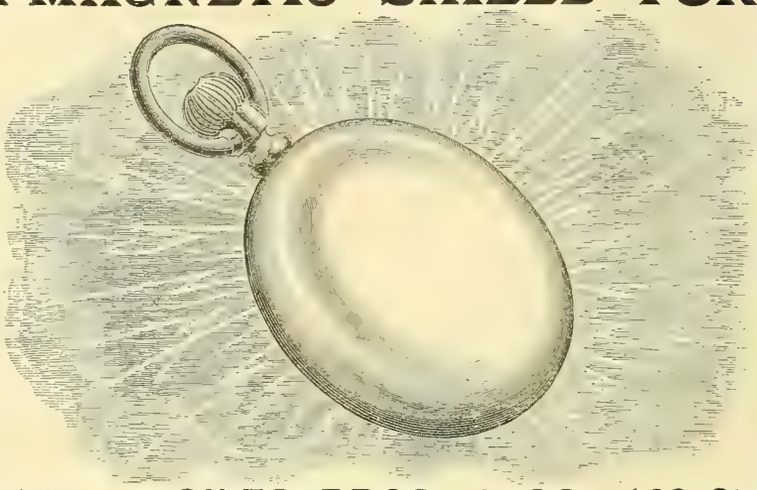

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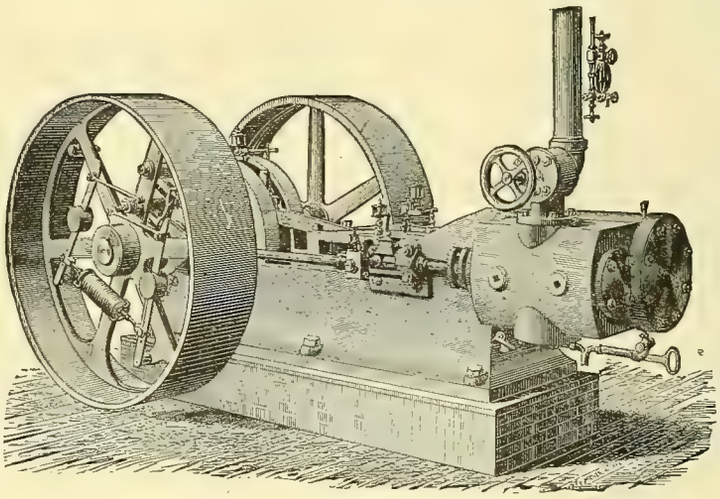

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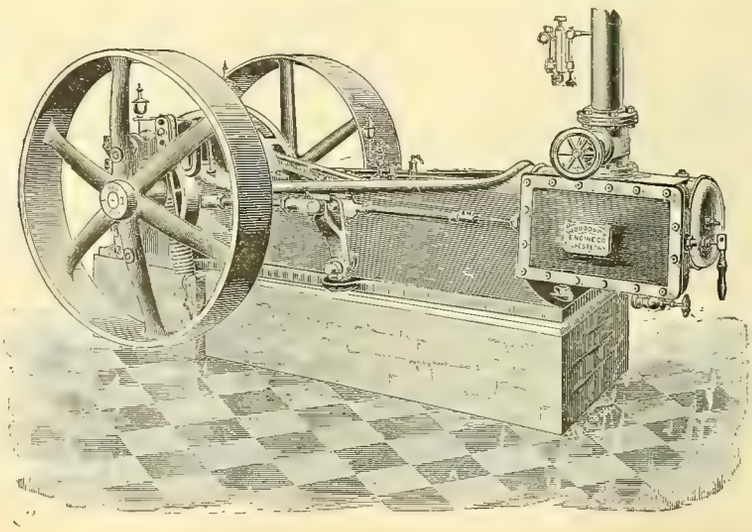

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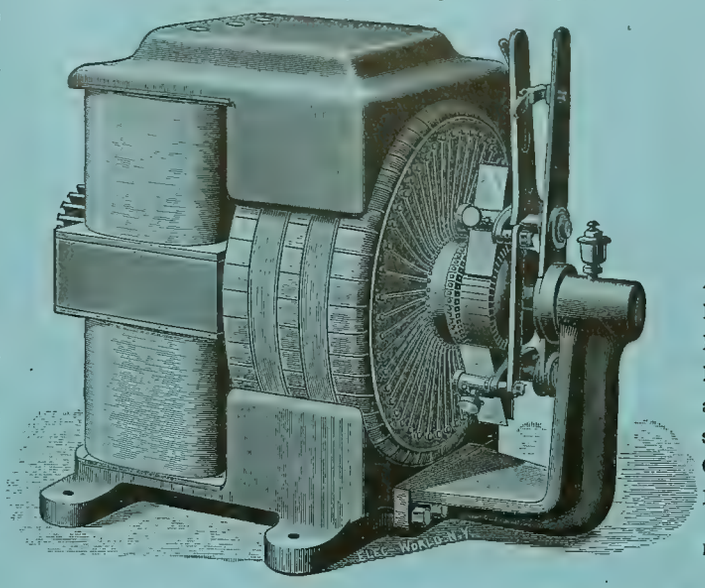

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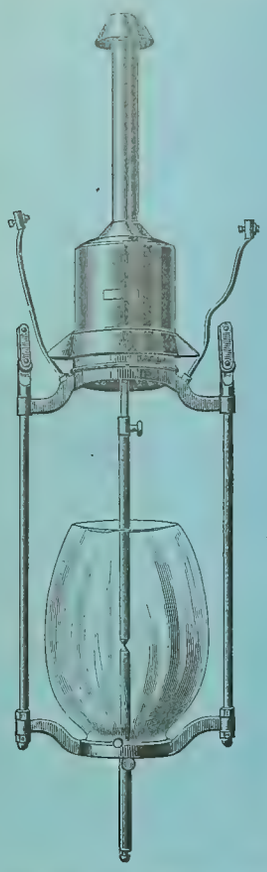

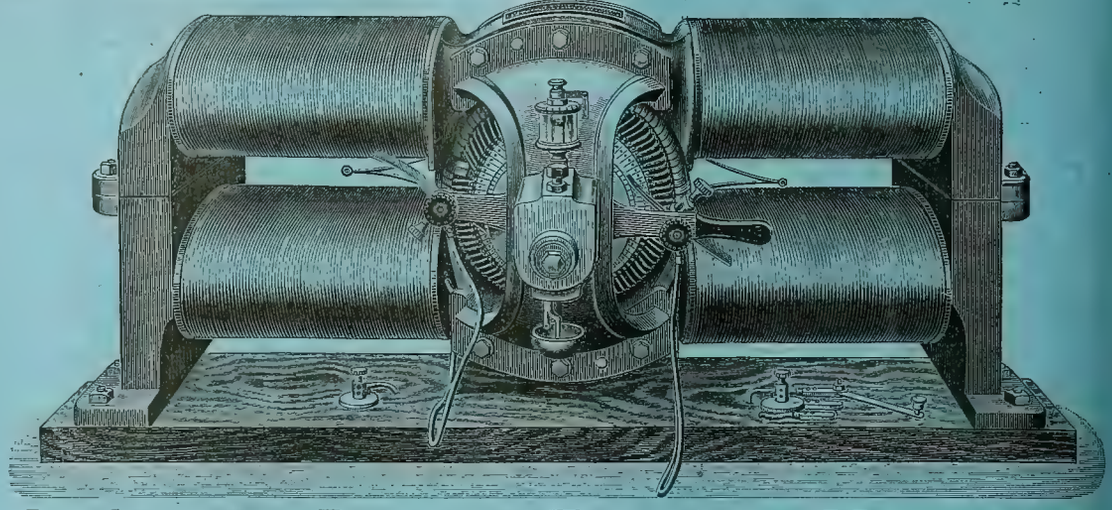

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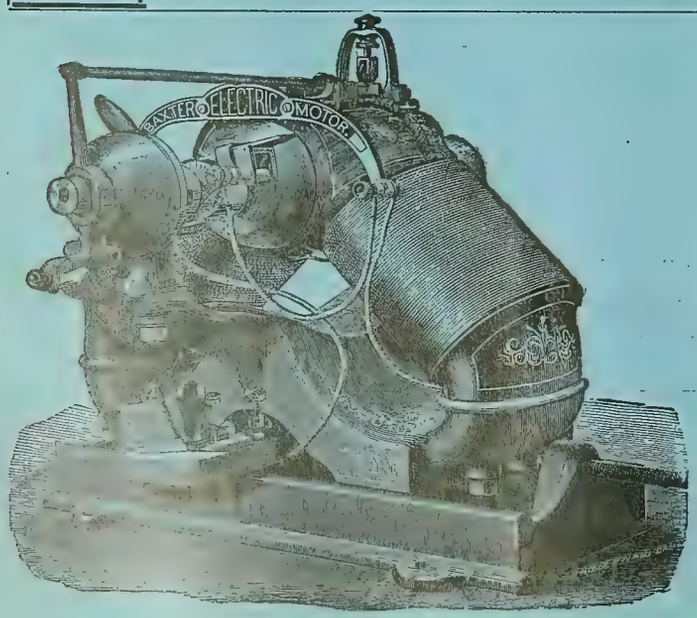

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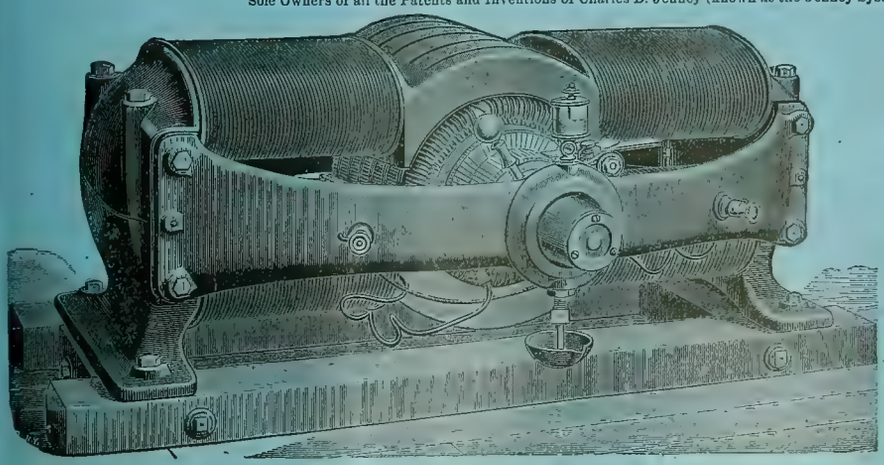

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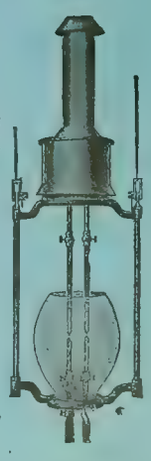

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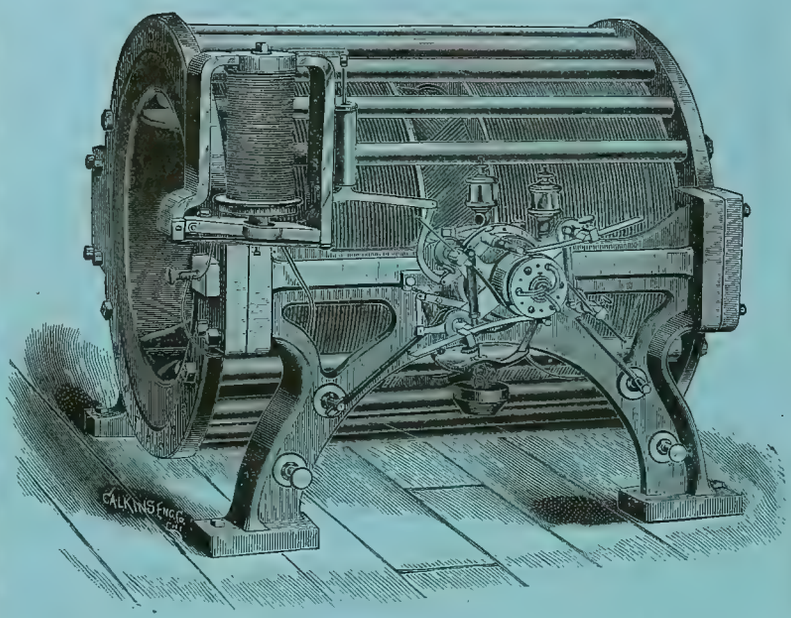
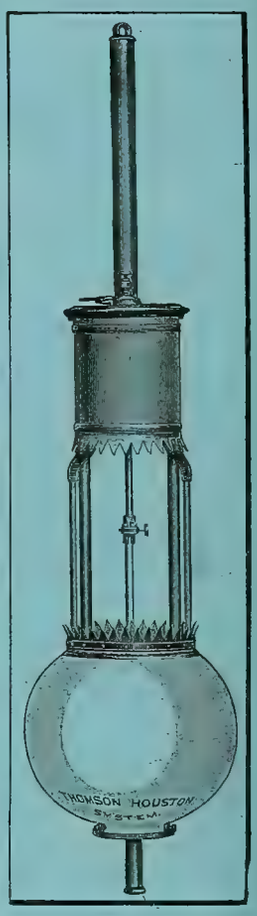


The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.



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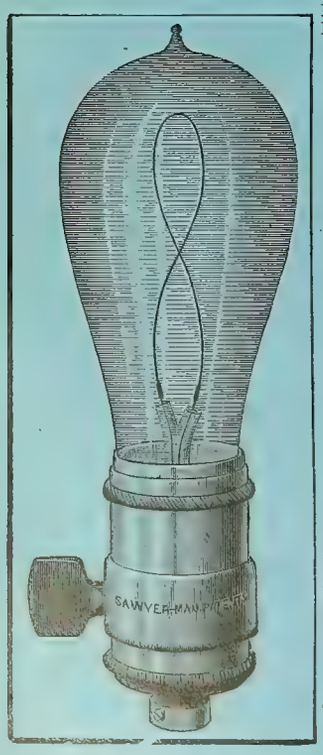
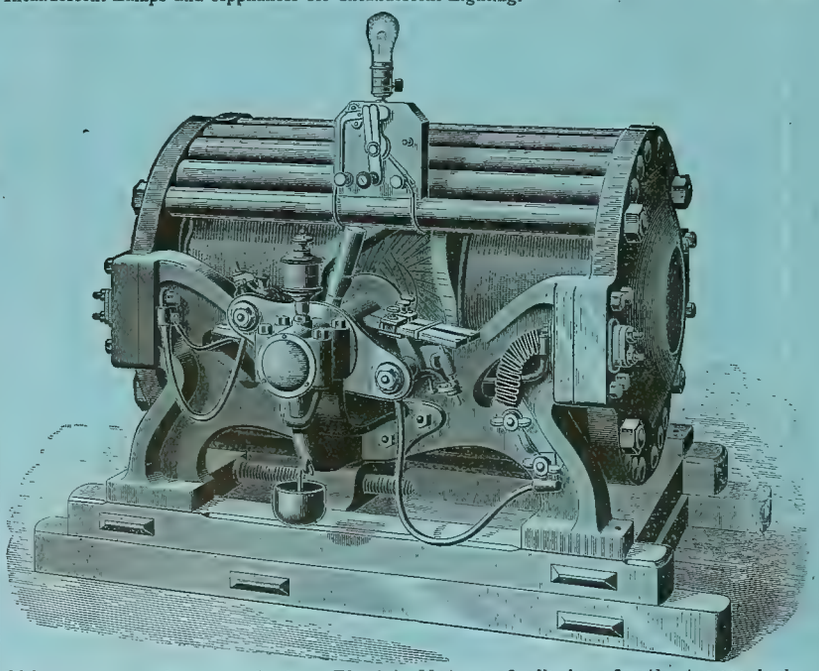
AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





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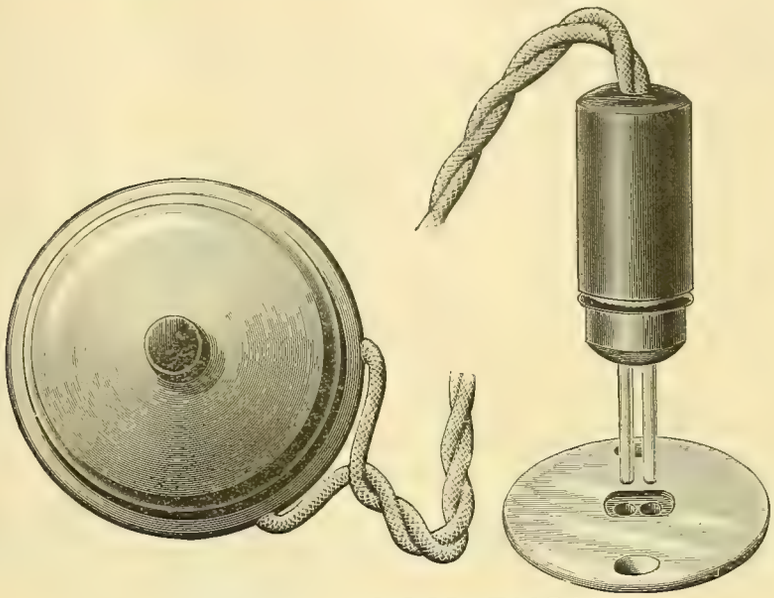

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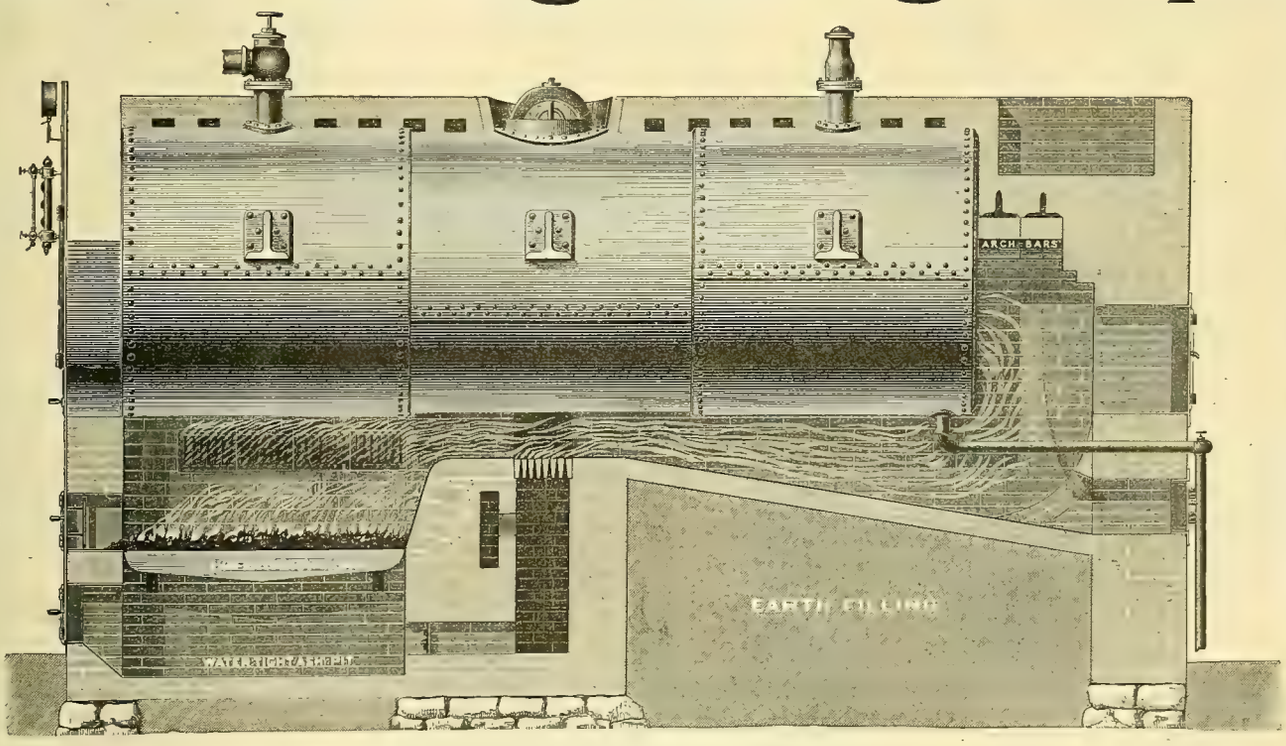

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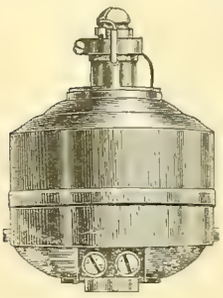

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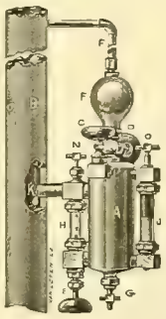

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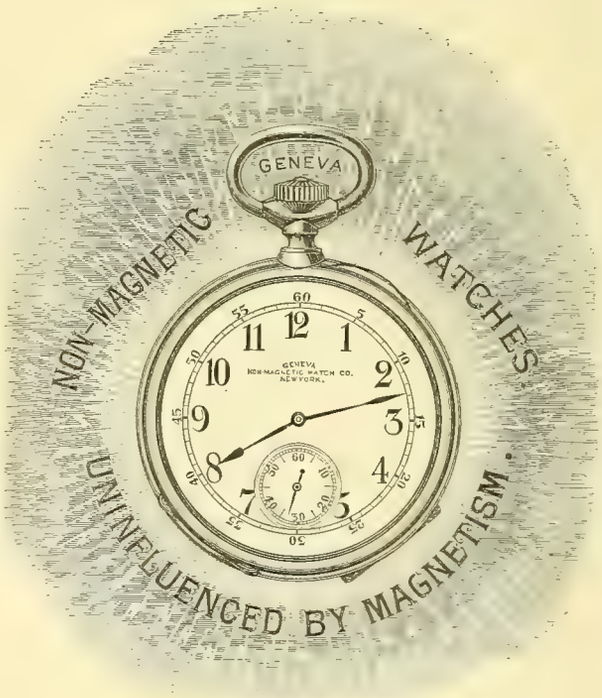

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Quick Make and Break Uncontrolled by the Handle.

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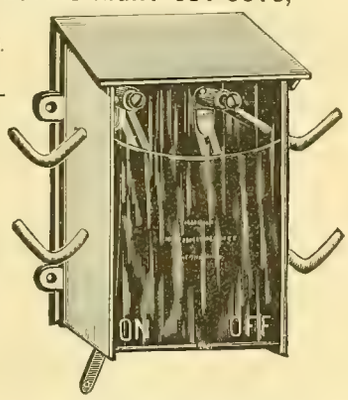


W. B. CLEVELAND, Proprietor, 26 S. WATER STREET, CLEVELAND, O.

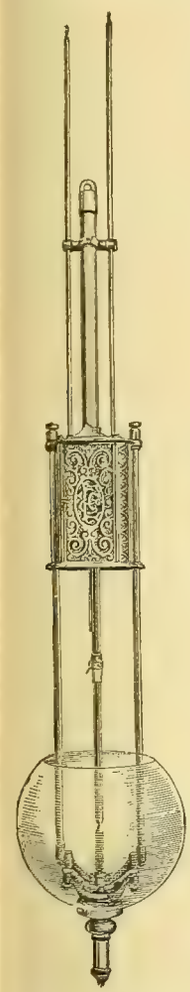
Chicago Electric Club.

There will be a meeting of the CHICAGO ELECTRIC CLUB, Monday evening, December 5th, at 8 o'clock, at the rooms of the Club, 122-124 Clark Street.

GEO D. ALLEN, GEN'L MGR., WM. HOCHHAUSEN, SUP'T AND ELECTRICIAN

Excelsior Electric Company,

9 Dey Street, New York. Factory, 204 to 216 Willoughby Street, Brooklyn, N. Y.



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By reason of its new Automatic Regulator that does not depend on merely shifting the brushes, but cuts out a portion of the field magnets as each light is turned off, saving the power in proportion to number of lights burning down to one light.

Dynamo is the simplest of all makes and requires no attention except to keep it clean. The lamps are ornamental, can be used in connection with any system from seven to fifteen amperes without change of magnets.

The first and only system where Incandescent lights are successfully running off Arc Light Circuits.

Twenty-five dollars will repair our dynamo in places that cost seven hundred dollars on other systems.

Our system is original, and not copied after foreign obsolete patterns.

Our prices are reasonable.

The only system that has local companies paying 40 per cent. and above on its capital stock.

We take the contract wherever we bid.

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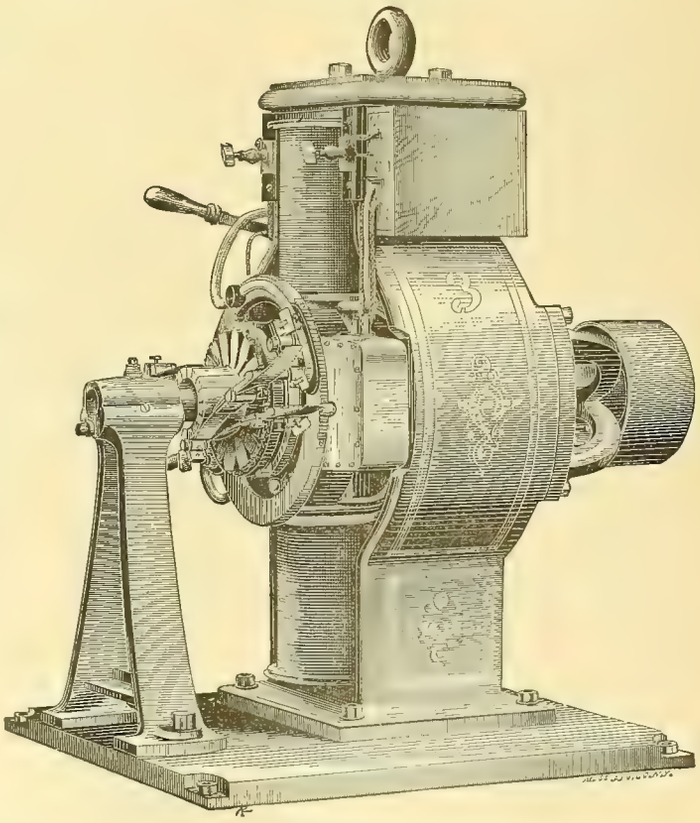

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We have a considerable quantity of **KERITE WIRE** size No. 13 B. & S. Gauge, 6-32″ insulation, which has been in use, but is practically as good as new.

We will send a sample of this wire and quote a very low price to any one who inquires.

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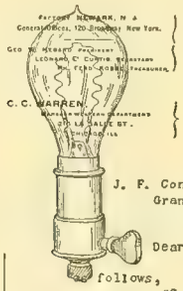

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Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

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Less wire per lamp.

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the most for the least money.

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Factory NEWARK, N. J. General Offices, 120 Broadway New York.
Geo. M. Hobart, President. Leonard C. Cushing, Secretary. Wm. Fish Cobb, Treasurer.

C. C. WARREN, Manager Western Department, 216 La Salle St. Chicago.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT,
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously insyalled by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 600 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C C Warren Esq.
Dear Sir. I have written the answers opposite your questions above as per your request, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.
Yours truly J. F. Conklin.

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, NOVEMBER 26, 1887. No. 22

The Electric Motor and the Derrick.

Every day brings before the public some new application of the electric motor, in some cases vieing with the steam engine, in others opening up a new field for the use of power. The accompanying illustration shows a Sprague electric motor used in hoisting stones on the new capitol building at Topeka, Kan., a brief note of which was made in an earlier issue of the WESTERN ELECTRICIAN.

A five horse power motor is belted to loose and friction pulleys which operate the hoisting drum and worm gearing, admitting of the manipulation of the machinery with more exactness than could be attained by steam power. Stones of eight tons are readily handled.

As will be seen the motor is housed on the truck that carries the derrick and the winding gear. The wires are hung in such a position that the motor can be moved 100 feet each side of the pole. On the second story of the same building is another motor used for a similar purpose, and in the basement still another five horse power motor operating brick and mortar hoisting machines, stopping and starting automatically. The colored man who fills the hods with mortar, is engineer-in-chief of this machine.

The building contractors are more than pleased with the form of power and the rental they pay to the light company is less than what it would cost to operate by steam, and yet it affords a good margin to the electric light company.

When the fact is taken into consideration that the motor is only doing its work when hoisting, the average number of hours of work done per day is small.

Chicago Electric Club.

President A. K. Stiles occupied the chair at the meeting of the Chicago Electric club last Monday evening. The routine business was quickly transacted. Secretary Kreidler announced that the membership roll showed 131 resident and 46 non-resident members, a total of 177.

The amendments to the constitution and by-laws, presented by E. P. Warner, at the meeting of Oct. 17th, were taken up and adopted. They follow; the first is a new amendment, the second a change necessitated by the adoption of the first:

"Article II, Sec. 8:—Any person who shall be nominated by the board of managers, may be elected an honorary member by a unanimous vote, at any annual meeting, and shall be exempt from all dues, but enjoy all the privileges of other members except voting and holding office."

"Article II, Sec. 1:—Members shall be classified as resident, non-resident, and honorary members."

Charles J. Van Depoele had been announced for a paper on the operation of electric street cars but found it impossible to prepare it in time, for the meeting last Monday night. Mr. Haskins consented to fill the breach and presented the paper reproduced elsewhere, entitled "Coupling of dynamos on the same external circuit." The discussion in brief will be found in connection with the paper.

A hearty vote of thanks was extended to Mr. Haskins.

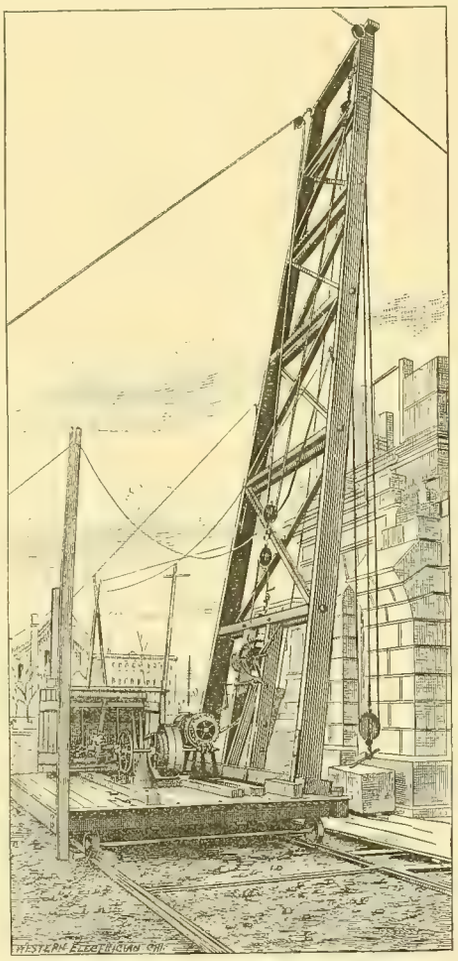
The next meeting of the club will be held Dec. 5th, when Mr. Van Depoele will present his paper on the operation of electric street cars.

Coupling of Dynamos on the Same External Circuit.[1]

By C. C. Haskins.

I would wish it understood that I present this note for two reasons: Because it is my wish to supply the place which a better paper was expected to fill and was unavoidably postponed, and in the hope of eliciting a discussion on the subject of coupling up dynamos for electric lighting or power. On the principle that half a loaf is better than disappointment, I crave your attention for a short time only, after which I trust we shall all be enlightened by a thorough discussion of the subject.

In the practice of electric lighting there exist many problems affecting economy, perfection of



results, matters of various natures, which are ever before us for discussion, for rejection or adoption. Among these, one of the most important, bearing as it does on the efficiency of a plant, is the connecting up of generators, and the disconnecting of these, as well, without disturbing the uniformity of the light intensity in the circuit, or otherwise deranging the well-being of the plant.

A recent work by M. von Gaisberg contains many suggestions on this subject, and it is largely from this work that the matter I am presenting is taken.

In large lighting establishments—central stations and the like—many generators may be joined up in parallel arc, and deliver their current to one or more divisions of the lines pertaining to the central station. This is especially convenient in systems where the e.m.f. is a constant.

It is necessary that machines thus associated should be of the same character, as to winding, and in all respects the nearer they resemble each other, the more readily they will synchronize, and work together.

In Fig. 1 we have a pair of shunt-wound generators coupled up for quantity—a combination of two incandescent machines. The brushes of the same name $a'a''$ are connected directly to the conductor A. The opposite brushes marked $b'b''$ form contact with the other conductor; through the switches, which are here represented as keys, marked $H'H''$. The inducing, or shunt wire, makes contact with the brush holder at a', while the other contact, after leaving the field, takes hold of the other main wire outside of the switch H'. This shunt wire has also a switch or key $x'x''$ which enables the operator to cut off the current which energizes the fields. These two switches are placed, in practice, where it is most convenient for the operator. In the diagram they are arranged so as more readily to show their function without confusion in the lines.

Current regulators $R'R''$ should also be placed near each other, for convenience in manipulating. Safety strips are placed in the main wires marked $s's'$ $s''s''$, and at $S'S''$ are ampère-meters, while a single voltmeter is made to do duty for the combined machines.

This voltmeter is attached directly by one of the terminals to the conductor A, common to all the generators in the combination; the other to a switch u, in which the lever may be attached to either b' or b'' as occasion requires. The dotted lines show the two routes for the current flow.

Necessity or economy may require that all our machines shall be run simultaneously; or under different circumstances, one after another may need to be put in motion. The first case is most readily satisfied, and it is the most usual; for example where two generators comprise the plant.

We first close the two switches x' and x'' and then H' and H''. When the machine have acquired the normal speed the regulators R' and R'' are set for the proper e.m.f. The current should be equally distributed between or among the machines. If, for instance, the ampère-meter of one machine shows a discrepancy in this regard, the dynamo is at once brought up or down by means of a rheostat, to correspond with the others.

If at the commencement of the working day only a single machine is required, the above method, with, say number I machine alone, is followed, leaving the other machine or machines out of the question. When, later in the day or evening, there is a farther demand upon the station, the second machine is brought into action. Having started the dynamo, the switch x'' is closed, the voltmeter looked to, and when this indicates a correct condition of pressure, the regulator R'' is placed approximately correct, and the switch H'' is closed. The regulators are then brought to their corrected normal positions.

In adding still another machine the methods are the same; the combination already in action is considered as one, and the third machine is brought into the combination similarly to the last.

To shut down the plant we may throw off the brushes simultaneously, then open the circuit, or throw the brushes off successively.

1 Read before the Chicago Electric Club, Nov. 21, 1887.

In the latter case we commence by opening the switch H' then x' and then raise the brushes.

In more extensive systems, groups of lamps are sometimes placed in the dynamo room, each having their separate switches. These are used for the preliminary adjustment of the machines, before these latter are let into the lamp circuit proper, to prevent irregularities in light in the outer circuits.

One of the poles in this combination [Fig. 2] makes contact with the conductor A, and through this to all the machines. The other pole has a separate conductor, E, and is connected through switches to the opposite terminals of each generator.

In Fig. 2 we have upon each machine two switches y and x connected to the shunt wires. One of these, y, is connected directly to the generator, while the other, x, is in derivation with the conductor B. This second switch is necessary to prevent reversal of the generator. When we wish to put an additional machine in circuit the current produced by the acting machines is run through the fields of the new machine to energize them. The regulators, R, should be as near as possible to each other. They are sometimes arranged by combinations so that a pulley common to all will regulate the whole, or permit of their being regulated singly. A second voltmeter is sometimes found in large central stations. This is connected directly to the main conductors A and B.

Usually, at least at the commencement of the working day, the machines are put into service one after the other, as required. If, for example, we commence by throwing number I on the line, we start it as above indicated. Then, to set number II at work, we close the switch x'' after the proper speed of revolution has been reached. The e.m.f. of number I is noted; then the same voltmeter is thrown upon number II. Then the short circuit switch e'' is closed, and groups of lamps are gradually switched in, until number II is doing the same work as indicated for number I. In the mean time the regulator R'' is adjusted. The switch H'' is then closed, and switch e'' opened, y'' is closed. Finally x'' is thrown open, and the work is complete.

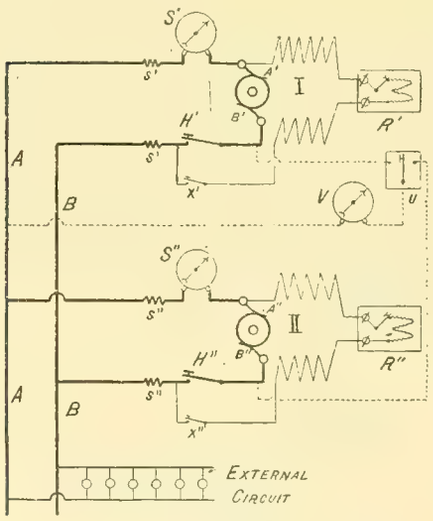


Fig. 1.—Coupling of Dynamos on the same External Circuit.

In withdrawing a generator from the circuit at a time when there is a less demand for light or power, the groups of lamps are again used to prevent oscillations in the exterior current during the change.

Switch E'' is closed (No. II machine), the lamps, group by group, are inserted, the current flow and the pressure are equalized, and H'' is opened. Then, by degrees, the groups of lamps are extinguished and the machine is thrown out of service.

To do this last without the aid of the lamp groups, we first open the switch H'', and after the switch y'', as has been stated above.

Figure 3 is a representation of two compound wound generators, coupled for quantity. When the machines are in circuit the brushes a are in direct connection with each other through the main wire A. The brushes of the same name or polarity must all be connected. The brushes c are connected through the conductor C. This wire should be ample in size—say 3 to 4 millimeters diameter. When the generators are in circuit their terminals b are connected by the common conductor B. Each machine is furnished with an ampère-meter, S, which is placed in the main line near the machine. A four-point switch H permits of throwing the machine in

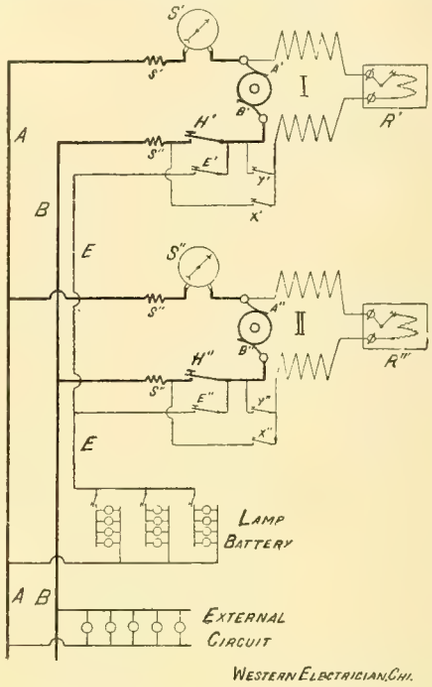


Fig. 2.—Coupling of Dynamos on the same External Circuit.

and out of service, by simple changes, as shown. Independent of these switches H, it is necessary to place switches at x for the shunt portion of the circuit—the inducing or field coil circuit.

This wire is attached on the one hand directly to the brush c, on the other hand outside the switch H, it is attached to the main wire A.

The regulators should, as before, be so placed as to be most convenient for rapid manipulation and so arranged as not under any circumstances to interrupt the current.

Under no circumstances should there be any omission of the safety strips, s' s''. The voltmeter should be capable of being thrown by switches, upon either of the several machines.

To put the generators at work, the process is similar to that indicated above. If it is desirable that they should be thrown in simultaneously, at the commencement of the working hours, we close each x and H, insert the resistances, and as soon as the normal speed of the machines is attained the line is switched on. The e. m. f. of the current is then regulated. It may be necessary to set the dynamo in motion before closing the switches, x first, H afterward.

For putting number II machine in circuit for example, when others are already in operation, the switch x'' is closed, and when the normal speed of the machine is attained, the regulator R'' is placed approximately where those of the moving machines are. Then, provided the voltmeter indicates the proper pressure, the switch H'' is turned, which places the additional machine at work.

To shut down the plant, one of two methods may be adopted: All of the machines may be thrown out of service at once at the brushes, or these may be taken off one at a time. In the latter case the switch H is first opened, then x, and afterward the machine may be thrown out.

When the brushes as well as the terminals are connected in parallel circuit, the compound machine is claimed to work quite satisfactorily and exercises a considerable power of self-adjustment, according to Thompson, readily correcting minute discrepancies arising from slight differences in the slip of the belts, trifling differences in pulley diameters, etc. The explanation of this compensating action is thus given: In the case of two precisely similarly constructed compound machines, connected by shunts so that the armatures as well as the terminals are in parallel, the strength of the fields in the two generators will be the same—and of course the e. m. f. will be equal. They must therefore absorb equal power and do equal work. But now, if one, from any cause gets behind, its e. m. f. will be reduced in consequence, it will absorb less power—the slow machine will tend to race, while the faster one will tend to slow down, resulting in continued mutual adjustment.

Still another method of connecting these machines has been suggested. It consists in employing the current of machine number I to energize the fields of machine number II, while the current of II is in turn used to energize I. In compound machines, of course, only the series circuits should be thus connected. The dynamos must be exact duplicates in all electrical peculiarities. There is, however, a serious objection to this method of coupling—simply this: That in order to utilize one machine the second must be run at a loss, save where a complicated system of switches is used; and in the event of a change being necessary while either or both machines were in operation, an interruption of the outer circuit, with its consequent violations of English grammar, and outrages of polite diction must result.

Series wound machines are most readily coupled in series or tandem, for doubling the e. m. f. This is so simple as to require no explanation, and no further care is needed save the usual precautions relative to all circuit and switch contacts, and a certainty that the dynamos are all headed in the same direction.

The coupling of alternate current generators has been the subject of much controversy, and there are to-day those who claim that this can not be done successfully. I am not at all sure that it would not be fully as well that way. However, Wilde, in 1869, showed that this was both possible and practical.

Wilde's process was not thoroughly perfect, I think, but about a year ago, Siemens & Halske brought out an ingenious method for synchronizing two or more machines generating alternate currents. Let us suppose that with one machine running we require an addition of one or more. Of course you all comprehend that in order to

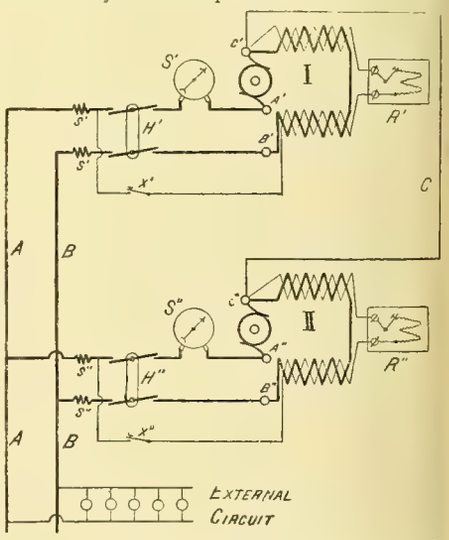


Fig. 3.—Coupling of Dynamos on the same External Circuit.

work together all must send an impulse of the same character to line at the same instant, for if the two are opposed the result would be something like a collision between a couple of torch-light processions. Well, suppose machine I is running, and we desire to throw in II and III. The machines are so connected that their two poles of the same name send their current through one-half of a magnet coil, and through a common terminal to line. The similar pole of the acting machine has a branch leading through the other half of the magnet, and to line through the same common terminal.

The windings are such that the magnet requires the combined current of the three machines to close the armature, and this effect can of course, only be produced when there is perfect synchronism. This once accomplished the armature closes, cuts out the derivations, and the vibratory

phase, having been once established, its tendency is to remain constant, and common to all. Should anything occur to reduce the magnetic strength of the coil, the armature opens and the adjustment of impulses commences anew.

The discussion of the paper was opened by Professor Badt, who said : "In relation to Figs. 1 and 2, I would say that, though the connections are theoretically correct, things can not be practically manipulated as described by Baron von Gaisberg.

"If, for instance, dynamos number I and II should be generating current, and it should be desired to throw number I out of the circuit and switch x' should be opened, a powerful extra current would be set up in the field of the number I dynamo, which would probably destroy the insulation of the field. The proper way of throwing number I out of the circuit would be to open H', then introduce a considerable resistance into the field of number I dynamo, thus reducing the flow of current through the field, and then open x'. This whole combination of switches and resistances would be so complicated that in practice it would be preferable to do away with switch x entirely. The disadvantage of such an arrangement would be that a certain amount of current would be lost all the time in energizing the fields of the dynamos, which were not delivering current into the main leads, but this small loss of current is more than equalized by the great advantage obtained by the much simpler system. There is also no necessity of a lamp battery. If there is a reliable voltmeter connected as shown in Fig. 1, and the dynamos are brought to about the same e.m.f. before being thrown into the circuit, no fluctuations of the lights will be perceptible. This is only true, however, when all the dynamos are driven from the same shaft. If separate engines should run the dynamos, a lamp battery will be almost a necessity, as the speed of the engine, and hence the e.m.f. of the dynamo would decrease when the load was thrown on.

"To set the regulators exactly alike as recommended by Mr. Gaisberg is of very little practical value, as the e.m.f. of the dynamo may be raised and lowered 10 and more volts by simply moving the brushes one-eighth of an inch above or below the normal point. The only correct way is to use a voltmeter.

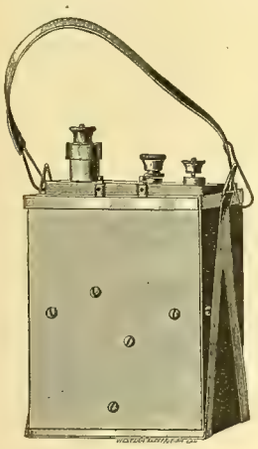


Fig. 1.—New Combination Sets.

"Pilot lights connected direct between the brushes of a dynamo will also indicate about the proper e.m.f. of the dynamo. The system, as explained by Mr. Gaisberg is, in its details, impracticable.

"Concerning Fig. 3 let me say that, to my knowledge, there are no compound wound dynamos connected in multiple arc in the United States to-day. Compound wound dynamos will never run as smoothly in multiple arc as shunt wound dynamos, in spite of all precautions.

"In reference to alternating current machines it has been shown lately that they will run in multiple arc, I might say better than continuous current machines, even without the aid of extra instruments to synchronize the machines.

"I agree with Mr. Haskins when he says dynamos can be very easily connected in series without any trouble at all, but this is only true for series wound dynamos. If he had ever attempted to connect compound wound or shunt wound dynamos in series he would have found that extra precautions must be taken, and this same amount of complication is necessary to prevent the dynamos from reversing each other."

Mr. Haskins said he did not, by any means, agree with the author from whom he had quoted, and whose diagrams he had reproduced, but he had brought the matter before the club to awaken discussion.

Mr. Cutter, of the Thomson-Houston company, said that in New Haven his company had compound wound machines connected in multiple arc, and that in Cleveland they also had compound wound dynamos connected in multiple arc. He agreed with Professor Badt in that

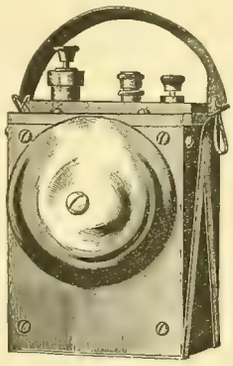


Fig. 2.—New Combination Sets.

alternate machines could be connected in multiple arc much easier than continuous current machines.

Professor Badt replied that he was not familiar with the New Haven station, but that he was thoroughly conversant with the station in Cleveland. There were two Thomson-Houston compound dynamos there, which are used for lighting the Euclid avenue opera house, connected, not in multiple arc, but in series.

Chas. J. VanDepoele, who had not been present during the reading of the paper or Professor Badt's remarks, spoke in favor of large continuous current machines, the fields of which were excited by a separate exciter.

Mr. Cutter said the tendency in Europe was toward the use of large alternate current machines, and this statement was corroborated by Mr. Bliss from private correspondence.

The comparative economy of continuous current and alternate current machines was discussed. Mr. Van Depoele thought they would compare favorably. Professor Badt said a comparison between the two kinds of dynamos should be between the continuous current machine and the alternate current machine of to-day, and not the alternate current machine of two or three years ago, for that machine was no more like the alternate current dynamo of to-day than the old slide valve engine like the modern automatic cut-off engine. In the older alternate current machines there was very little iron in the armature, while in the modern machine there were large masses of iron in the armature. He was of the opinion that the alternate current machine was just about as economical as the continuous current dynamo.

The discussion then turned upon the dangers to human life from electricity, which were exhaustively treated in a paper read before the club by Professor Badt some months ago.

New Combination Sets.

On this page we give additional illustrations of new combination sets made by the Globe Electric company of Cleveland, O., supplementing those published last week.

Fig. 1 represents a fire and temperature alarm. The apparatus consists of a battery, thermostat and bell permanently connected ready for use. It may be hung up or placed upon a shelf or table in a room or any other place where it is desired to call attention to the rise or fall of the temperature above or below the degree to which the apparatus has previously been set ; thus a uniform temperature may be maintained which is very desirable, if not essential, in sick rooms, school rooms and other large assembly rooms, or in homes where the temperature is often allowed to rise or fall suddenly to such an extent as to entail serious consequences to the occupants. Placed near a furnace or base burner stove the alarm will sound whenever attention or a fresh supply of fuel is needed. It is also found very useful in greenhouses and incubators for the same purpose. As a simple fire alarm its merits will be at once recognized. The whole apparatus is fitted complete in a polished black hard rubber case with electro-plated mountings, and is supplied connected and ready to operate at any desired degree of temperature to which it may be set There are four different forms of thermostats employed in these sets. In Fig. 1 the thermostat is inclosed and set to any fixed degree ; in another form the thermostat is exposed and adjustable to any increase of temperature ; these forms are specially suited to fire alarms ; the third form is adjustable to high and low temperature, and so is the fourth, the latter being furnished with a dial and regulating or adjustable stops.

Fig. 2 is an invalid's portable electric bell set, complete with battery, bell, push, and 30 feet of flexible conductor which is wound on a reel within the case. This set may be employed for any of the purposes for which electric bells are or can be used either temporarily or permanently. It possesses the advantage amongst others of being self-contained and always ready for use, the only trouble in connecting one room with another being the unreeling of the covered flexible conductor and carrying it and the push to the rooms from which the calls are to be sent. The battery and bell may be placed upon a shelf or hung up in the room occupied by the person to be called, while the call button may be placed on the couch, table or other convenient place near to the invalid or caller, who, without painful turning of the body or more than the slightest movement of the hand, can summon the attendant. The business man with the call button lying on his desk need not raise his eyes or lift his pen to summon a clerk or messenger from any place where the bell is located. The housekeeper need not turn in bed or open her eyes to awaken her sleepy help. Where the conducting cord is not required, as for instance, when the bell is employed on the dining table, it is wound within the case. This same set answers as a burglar alarm by substituting for the push button a special attachment to a chamber or

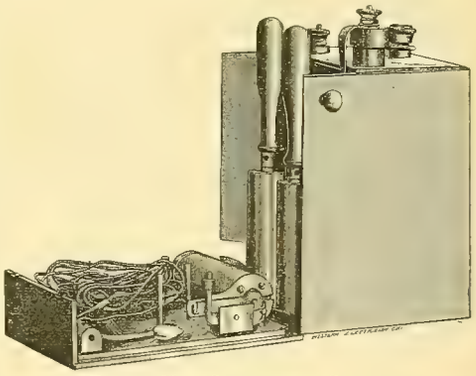


Fig. 3.—New Combination Sets.

other door or window. These alarms are permanently or temporarily attached to the inside of doors or windows which on any attempt to open from the outside will start the alarm. Commercial and other men traveling with valuables will find this a better protection than a dozen sharpshooters, as all the occupants of the house are put on the alert on the sounding of the alarm, and the would be-thief is scared away by it. There is generally one door or window in every house to which is attached greater importance than any other ; to such this alarm could be secretly and either permanently or temporarily attached so that the alarm would sound on any attempt to open or tamper with it. The same applies to cupboards, drawers, safes, boxes, closets and storerooms. A bell, buzzer, or fuse is the means employed for giving the alarm. The bell alarm would be noticed by the burglar who would be scared away ; the buzzer would only be heard by the occupant of the room or person in

charge who might catch the thief in the act, while the fuse which gives out a report louder than a revolver, would be fired near the ear of the thief when attempting to open the door.

Fig. 3, as will be noted, is a combination physician's or family medical induction apparatus, consisting of battery, induction coil and regulator, switch, insulating handles, conducting handles, sponge holders, flexible conductors,—in fact a complete apparatus,—all contained in a polished hard rubber case, the whole forming a neat and portable outfit of considerable range, easily and simply regulated from a very weak current scarcely perceptible to the most delicate or sensitive, to a powerful current.

Theory of Telephone Circuits.

BY DR. V. WIETLISBACH IN *Elektrotechnische Rundschau.*

PART II.

By specializing we shall easily reach the two cases which had occupied our attention. We shall not revert to them, but will give our attention to another important special case.

If we investigate a form of vibration which is composed of several simple waves, and which corresponds to a determinate acoustic sound, we find that this is changed by telephonic transmission in three different ways. In the first place, all the amplitudes become smaller and the intensity is constantly weakened as a general thing; then the individual waves become mutually displaced or their phases are changed, as the rapidity of propagation of various high tones is variously great. These displacements are of no importance in actual practice, as the ear has the power of analyzing a sound into the separate simple waves which compose it, and in this the phase is not taken into consideration. The most important change is distortion of the form of the vibration, which is itself caused by this, that the weakening of the amplitudes by the four electrical factors W, L, C, A, may become larger or smaller according to the number of vibrations. It is this distortion which limits transmission in cables as well as in aerial iron circuits to such comparatively short distances. The main object for practical experts must be to remove this distortion as far as possible. We can at least partially remove the influence of the number of vibrations from our formula and essentially simplify the formula in case the following relation exists:

$$\frac{W}{L} = \frac{A}{C} = \frac{1}{a}$$

J, the current strength, then becomes the following simple equation:

$$J = 2 \cdot \sqrt{\frac{A}{W}}\, E \cdot \frac{e^{mt}}{e^{P} - e^{-P}}$$

in which

$$P = \sqrt{A \cdot W}\,[1 + a\,m\,i].$$

If we separate the actual from the imaginary, we will have:

$$J = 2 \cdot \sqrt{\frac{A}{W}} \cdot E \cdot \frac{e^{mt}}{(e^{l\sqrt{AW}} - e^{-l\sqrt{AW}})\cos l\sqrt{AW} \cdot am + i\,[e^{l\sqrt{AW}} + e^{-l\sqrt{AW}}]\sin l\sqrt{AW} \cdot am}.$$

The cosine vibration $V_0 = E \cos mt$ gives us:

$$J = 2 \cdot \sqrt{\frac{A}{W}}\, E \cdot \frac{\cos(mt + d)}{\sqrt{[e^{2l\sqrt{AW}} + e^{-2l\sqrt{AW}} - 2\cos 2l\sqrt{AW} \cdot am]}}$$

in which

$$\operatorname{tn} d = \frac{e^{l\sqrt{AW}} + e^{-l\sqrt{AW}}}{e^{l\sqrt{AW}} - e^{-l\sqrt{AW}}} \cdot \operatorname{tn} l\sqrt{AW} \cdot am.$$

m, the number of vibrations, has now disappeared from the formula with the exception of the cosine factor in the numerator. The curve of the amplitude is, therefore, a wavy line, whose axis is parallel to the axis of m. Positive amplitudes are always larger than the negative ones. The size of the amplitudes and the lengths of the waves decrease with the length of the line. Therefore, with the assumption of Relation 5 the amplitude is not, as Heaviside [*Electrician*, 1887, June, page 79] erroneously conjectured, independent of the amplitude, but is a periodical function of the same.

For E=1	Maximum	Minimum	Axes	Period $= \frac{m}{2\pi}$
1 km	10^{-9}	10^{-12}	$1.4 \cdot 10^{-12}$	5000
10 km	10^{-10}	10^{-12}	$1.4 \cdot 10^{-12}$	500
100 km	10^{-11}	10^{-12}	$1.4 \cdot 10^{-12}$	50
1000 km	$8.5\ 10^{-13}$	$7.3 \cdot 10^{-13}$	$6.5 \cdot 10^{-13}$	5

The variations of the amplitudes around a medium value, that of the axis, are so considerable, that they may under circumstances in actual use become important. To illustrate the conditions which may obtain, I have in the above table arranged the maximum and the minimum of the amplitudes, the position of the axes and the size of the periods for lines 1, 10, 100 and 1,000 kilometers long, in which

$$W = 1\omega = 10^9;\ L = 10^8;$$

$$A = 10^{-15} = \frac{1}{10^6\omega};\ C = 0,1\varphi = 10^{-16}$$

and which thus almost corresponds to a copper aerial line of four mm. diameter and weak insulation.

We have graphically represented the results of this table in Diagram 1. These variations are so great that they may seriously imperil telephonic transmission. Fortunately they never manifest themselves to so great a degree as our formulas would seem to indicate, because we constantly introduce into the circuit apparatus which has very strong induction, and by which the curve of the current may be entirely transformed. The manner in which this is done we shall show later on, when we give attention to these composite circuits.

For long lines it may be very advantageous under certain circumstances to adapt ourselves to the special conditions, according to Relation 5. We shall be able to judge best of what it is necessary to do, by comparing the three cases which have been separately considered and given prominence:

$$C = 0;\quad W|L = A|C;\quad L = 0$$

The formulas which apply are:

$$(1.)\ C = 0;\quad J = \frac{E \cos(mt + d)}{L\sqrt{[1 + (W|mL)^2]}}$$

$$(2.)\quad W|L = A|C;\quad J = 2\sqrt{\frac{A}{W}} \cdot \frac{E(\cos mt + d)}{\sqrt{[e^{2l\sqrt{AW}} + e^{-2l\sqrt{AW}} - 2\cos 2l\sqrt{AW} \cdot m \cdot a.}}$$

$$(3.\quad L = 0;\quad J = \frac{E}{W \cdot l} \cdot \frac{\sqrt{2} \cdot \sqrt{mCW} \cdot l\cos(mt + d)}{\sqrt{[e^{l\sqrt{mCW}} + e^{-l\sqrt{mCW}} - \cos l\sqrt{mCW}}}$$

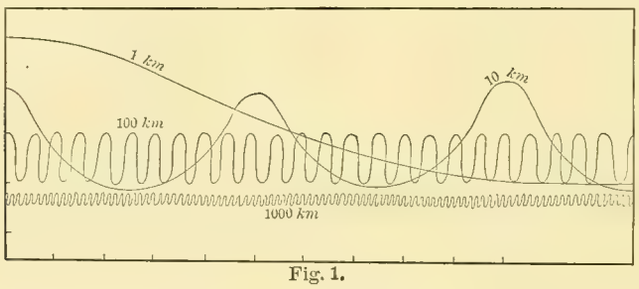


Fig. 1.

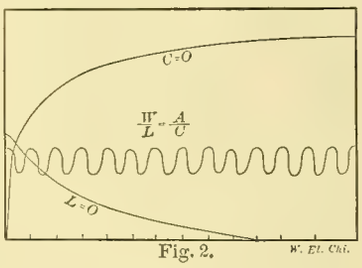


Fig. 2.

In Diagram 2 the amplitudes are graphically depicted as a function of the number of vibrations, and 1 is assumed to be one thousand kilometers. As for the rest the conditions are the same as above. This figure permits us to lay out a general picture of the change in transmission due to the relative change of the electrical qualities of a circuit.

Let us begin with the cable curve L=O. This has the form determined on page 15 of *Elektrotechnische Rundschau* of this year. [Page 5, No. 1. WESTERN ELECTRICIAN.] The deep waves are relatively too strongly reproduced as against the high ones. The curve therefore approaches the axis J=O with a pretty strong pitch. No periodical variation can be perceived. When induction makes itself manifest the curve straightens itself, but at the same time the wavy variation asserts itself until finally when Relation 5 has been fulfilled, the axis of the amplitudes becomes horizontal; the line of intensity however becomes a wavy line, which periodically disappears. If the capacity constantly becomes less, the axis of the curve of the intensity of the amplitudes turns itself reversely; the high tones are more strongly reproduced, the periodical changes disappear more and more, and disappear entirely when the capacity C=O, but in return for this the curve has become very strongly bent since beginning with zero it asymptotically approaches a final value $^1|L$.

Generally the distortion consists of two different parts: One in which the number of vibrations varies in a constant manner, and one which periodically increases and decreases with the number of vibrations. As far as I know this composite character of the distortion has nowhere received notice. The constant part is a function of the quotient of both factors A+miC and W+miL. The periodical part is on the other hand the product of these two factors. The results obtained from both are therefore entirely different, and in judging transmission we must take into consideration the constant as well as the periodical part. As the formulas show, insulation has an essential influence. It is true that the highest insulation does not always give the best results. On the contrary, it may happen that a moderate insulation is to be preferred. The main thing always is that it be as uniform as possible. In cables it is possible to make an insulating material which would approximately maintain a definite degree of insulation, which degree could be determined in advance. In aerial lines this is impossible. In fine weather these show the insulation of the dry air, and in actual use, provision may be made that the insulation be as good as possible in bad weather also. I have often heard the assertion that a certain telephone connection would work better in bad weather than in good. If we consider the periodical variations, it is easy to see that such a phenomenon is possible. It has also been asserted that cables with weak insulation worked better than those with high insulation. Isolated facts of this description of course do not establish anything. The most essential thing is the coöperation of the distinctive separate characteristics of a line, and into this theory only can give us a clear insight.

In the consideration above, the fact has not been taken into account that resistance and in-

sulation depend on the number of vibrations. When we are dealing only with copper wires our results may be approximately correct. For iron wires, on the other hand, the proper correction must still be introduced.

In the essays previously published we have devoted our attention to simple circuits; that is, those which consist of a homogeneous wire without any apparatus switched in.

This is a thing we never find in actual use. Apparatus is always switched in at the end of a line, and very often at a number of places in the circuit. At times the line itself is not homogeneous, but consists of different sections, for instance.of an air line and a stretch of cable. After we have become conversant with the manner in which telephone waves propagate themselves in a simple line, we shall, in several essays to follow, make an investigation of transmission in a composite line.

(Concluded.)

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

NUMBER XIX.

Electric Induction.—By electric induction is meant the influence which a charged conductor exerts on another conductor in its vicinity, insulated from it. It may be considered under two divisions, static induction and current induction; static induction pertaining to accumulators, as Leyden jars, condensers, and storage batteries, and current induction pertaining to the mutual influence of currents.

If an accumulator is charged positively it produces a corresponding negative charge on all bodies in its immediate vicinity, electricity equal to that of the positive charge being repelled from them; if negatively charged a correspondingly equal positive charge is attracted, and accumulated on them. In either case there is no electric transfer of such a nature as to reduce the original charge; the accumulator, if positively charged, loses no electricity, and, if negatively charged, it gains none. This is proved by the fact that, where surrounding objects are removed beyond the influence of the charged body, no permanent effects remain on them unless special means are used to render such effects permanent. This may be demonstrated by placing a gold leaf electroscope in the vicinity of the charged body, when the leaves will indicate the charge by their divergence, but on being removed they converge again. To make this effect permanent, let the plate of the electroscope, while under the influence of the charge, be touched by a conductor connected with the earth, a transfer of electricity will now take place, either to or from the earth, according as the charge is positive or negative, establishing equilibrium between the electroscope and charged body, as indicated by the convergence of the leaves, thus proving the fact of attraction or repulsion of electricity, as stated above; then on the removal of the electroscope from the influence of the charged body, difference of potential asserts itself and the leaves diverge. Now, since the electroscope is simply one of the surrounding bodies under inductive influence, so constructed as to indicate it, we must infer that all other bodies similarly placed are similarly influenced.

Induction can take place only through an insulating medium—as air, glass, or an insulating envelope—which is termed the dielectric. Its nature is not fully understood, but since there is no actual transfer of electricity, and since energy can act only through matter as its medium, it is evident that the dielectric, in some unknown manner, becomes the medium of this subtile influence. The definition, "direct action at a distance," formerly used by some leading electricians, is too vague, and has been abandoned since the nature of electric action has come to be better understood.

Current induction is of the same nature as static, modified by the properties peculiar to currents. That which we call continuous current is in reality a succession of impulses or infinitesimal currents, as has been already explained; and the conductor throughout its entire length, whether it be an Atlantic cable or a foot of wire, has practically, at each successive instant, a static charge, modified by the difference of potential between its extremities, by virtue of which the transfer of energy takes place; consequently this charged conductor, like other charged conductors, exerts inductive influence on adjacent conductors.

When a current flows through a wire it is found that the effect of induction is to produce an opposite current in any adjacent parallel conductor. The nature of this action may be represented by the following diagram:

(*a*.) + 10 + + + + + + + + + + 1
(*b*.) — 2 — — — — — — — — — — 1

Let *a* represent a conductor in which a current is flowing from left to right by virtue of the difference of potential represented by + 10 at the left and + 1 at the right, and let *b* represent an adjacent parallel conductor. Since inductive influence radiates from the charged body equally in all directions, only a small fraction of the lines of electric force radiating from *a* are intercepted by *b*; but, for convenience, we may represent this fraction by — 1 at the right, and — 2 at the left. Now since, as has been shown, the positive produces by induction an equal corresponding negative and *vice versa*, the positive potential in *a*, represented by + 10 produces, under the conditions named, a negative potential in *b*, represented at the adjacent point at the left by — 2, while at the right + 1 in *a* produces — 1 in *b*; and since electric movement is always from higher to lower potential, the current in *b* must flow from right to left, opposite to that in *a*.

Hence, when currents in two or more adjacent parallel conductors flow in the same direction, the effect of their mutual induction is to produce in each a counter current, which reduces the volume of the primary current; the effective current by which useful work is accomplished being then represented by the difference between the two. As in the illustration, if the primary current were represented by ten and the induced opposing current by two, the effective current would be represented by eight.

But if the primary currents flow in opposite directions, the effect of induction is reversed, and the volume of effective current in each conductor increased, as can easily be seen by the following diagram:

(*c*.) + 10 + + + + + + + + + + 1
(*d*.) + 1 + + + + + + + + + + 10

in which the current in *c* flows from left to right, and in *d* from right to left. The positive potential 10, at the left of *c*, induces at the same end of *d* a much stronger negative than the potential 1, of *d*, can induce in *c*, consequently the difference of potential between the opposite extremities of *d* must be greater than if *c* were removed, and hence its e.m.f. and resulting volume of current must be greater. And the same effect in *c* must follow from the difference of potential at the right between the 10 of *d* and the 1 of *c*. The effect of induction in increasing current quantity at the expense of current intensity, or intensity at the expense of quantity, has already been sufficiently explained in connection with the subject of transformers, treated of in Number XV. of these articles, so that further reference to it is unnecessary.

Magnetic induction, while strongly resembling electric induction, must be carefully distinguished from it, the one is the reciprocal of the other. Practically magnetic induction is found only in connection with iron and steel, and as we have seen, the construction and operation of the dynamo is dependent on the reciprocal action of magnetic and electric induction, the electric current being generated by the magnetic induction of the iron cores of the field magnets and armature, and reciprocally, the magnetism being generated by the electric induction of the current in the coils. The direction of the magnetic and electric currents produced by this reciprocal induction are always at right angles to each other, the magnet and the coil or line conveying the electric current, if free to move, always assuming this relative position with respect to each other.

At the National Grange meeting at Lansing, Mich., November 17th, resolutions were adopted favoring a government postal telegraph.

A Strong Consolidation.

A recent circular letter by Hugh R. Garden, vice-president of the Consolidated Electric Light company, New York, addressed to the stockholders of that company and the patrons of the Sawyer-Man Electric company, is of sufficient interest to electric light companies to warrant its insertion here. It follows:

"The Consolidated Electric Light company, owner of the Sawyer-Man patents, has, from time to time, received numerous applications for licenses to manufacture and sell the incandescent lamps, and other electrical apparatus covered by its patents, which applications it has been constrained to decline.

"With the view, however, of utilizing the inventions of others who have achieved success in the electric lighting field, and at the same time of concentrating and enlarging its business to meet the constantly increasing demand for its apparatus, the Consolidated Electric Light company has recently completed the following important transactions, which are of interest to its stockholders and patrons.

"First:—It has granted to the Thomson-Houston Electric company a license to manufacture and use incandescent electric lamps and attachments, in plants and stations established by that company in combination with its extensive and popular arc light system, upon an agreed royalty; and has also entered into contract with that company, whereby the interests of both companies, in the manufacture and sale of electrical apparatus other than that covered by the Sawyer-Man patents, are mutually promoted.

"Secondly:—It has purchased from the Westinghouse Electric company its valuable electric lamp factory and equipment at Pittsburgh, Pa., with a guaranteed capacity of five thousand incandescent lamps per day; and has entered into an agreement with the Westinghouse company whereby the purchasers from that company of its alternating apparatus—(the most economical and efficient for central station lighting)—shall also purchase from the Consolidated Electric Light company, the Sawyer-Man lamps and attachments, for use with such apparatus, and shall have the protection of the Sawyer-Man patents.

"Thirdly:—It has purchased the stock and assumed the control of the Sawyer-Man Electric company, which has heretofore been its sole exclusive licensee, and will conduct its commercial department through the agency of the Sawyer-Man Electric company.

"Fourthly:—It has purchased that valuable and extensive manufacturing and business property, Numbers 510 to 534 West Twenty-third street, in the city of New York, having a front of 325 feet on said street, with floor space of 117,000 square feet ready for use, and with a capacity for an increase to 200,000 square feet; being sufficient for the establisment, at that point, of its general offices, and of its principal legal, technical, manufacturing and commercial departments.

"To meet the increasing business demands of the Westinghouse company, the Thomson-Houston company, the Sawyer-Man company and the general public, the Consolidated Electric Light company will, within a short time, manufacture at its combined factories, at least ten thousand electric lamps, with the necessary electrical attachments, per day; and this demand, based upon the reputation for excellence which these companies have attained, in their respective fields of usefulness, will greatly enhance the value of its property, and will promote the interests of incandescent electric lighting to an extent hitherto unknown.

"This recognition of the Sawyer-Man patents, and consequent concentration of power in the Consolidated Electric Light company, is attended with a corresponding ability, on the part of this company, to protect itself from infringement of its patents; and steps have recently been taken, in the institution of new suits against infringers, and in the vigorous prosecution of those heretofore instituted, which, it is believed, will speedily and effectually secure to the company the additional profits from that source to which it is justly entitled."

The ground-wires motto. "*Adscriptus Glebæ*" —"Attached to the soil."

Western Electrician.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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THE life of the bucket-shop man in Chicago is not a happy one. A few weeks ago a temporary victory for the bucket-shop men was recorded in the form of a decision by Judge Collins who declined to dissolve an injunction procured by one of that ilk against the Board of Trade restraining it from interfering with the former in the way of withholding quotations. Monday, Judge Baker, in his charge to the November grand jury, called their attention to the fact that laws for the suppression of bucket-shops had been passed by the last legislature. He then gave the legal definition of a bucket-shop, prescribed the penalties and set forth the duties of a grand jury in investigating violations of the law. States Attorney Grinnell—he who conducted the prosecution of the famous anarchist and "boodler" cases—is back of the prosecution of the bucket-shop men.

THE second installment of the article on the theory of telephone circuits, by Dr. Wietlisbach, is given this week. The telephone is pre-eminently the outgrowth of the highest scientific development, and depends on those refined physical subtilties which are properly understood and appreciated only by minds of the highest scientific order; the intensity and amplitude of vibrations, the cause and effect of electric and magnetic induction, the subtile influences of conductivity and insulation, are the facts which underlie the whole system of telephonic transmission and constitute its very life; and while the ordinary inventor may accidentally stumble on to combinations involving such high scientific subtilties, and produce wonderful results, he is often quite incapable of comprehending the the nature of his own invention, or of pointing out the causes of important defects, and suggesting the remedy, and must leave this work to such men as Wietlisbach, Thomson, and others.

AT last Monday night's meeting of the city council of Chicago a resolution was passed, that a committee, consisting of the mayor and two aldermen, be appointed to negotiate with the several gas companies of the city for a lease of their several properties, for the term of ninety-nine years, or such other term or such other arrangement as may be agreed upon, and report the same to the council.

The order for an estimate of the expense of the city erecting gas works of its own also came up. It was amended so as to include the cost of furnishing gas for fuel and power purposes as well as light, and further by allowing ninety instead of thirty days for making the estimate, and as amended was passed.

The opinion expressed in these columns a week ago that such steps would be in the line of backward progress may be reiterated. Discontent with the poor illumination of the streets of Chicago resulted in an order directed to the city electrician to prepare an estimate for lighting a large territory by the electric light, the city to own and operate the plant. The data necessary are now being prepared. Meantime the advocates of gas have prepared and secured the passage of the resolutions noted above.

"AFTER the innings which American inventors have had on this side, it should be a source of gratification, not only to Prof. Forbes' personal friends, but the entire British race, if the new meter comes into universal use in the states," says *London Electrician* in an editoral note on the reception of Professor George Forbes and his coulomb meter, in America.

As eminent an authority as Edward Weston gave the instrument designed by the British electrician, all praise, and readers of this paper have had the opportunity of seeing a graphic representation of the meter, and have had the opportunity of studying its merits, brought out both in a description by its inventor and in the discussion that was awakened in the Institute of Electrical Engineers in New York. No warmer reception could have been accorded an inventor or invention than was extended Professor Forbes and his coulomb meter.

In the main our British contemporaries have been exceedingly fair and courteous towards American electricians, and have unhesitatingly awarded praise where praise was due. The implied compliment in the quoted excerpt should therefore be acknowledged by the repetition on our part of the desire for a practical tribute to the English electrician's scientific attainments, ability, and skill.

ALDERMAN ELLIOTT, of the Rochester, N. Y., common council, a week ago prepared a table designed to show primarily the amount of money paid by each ward of the city into the lamp fund, and the amount that each ward received from the city in lights within its territory. The report is made from data obtained in October and the first two weeks of November. It does not show the precise number of lights furnished by the electric lighting companies, for the three companies are still locating new lights in accordance with the contracts they have with the city. A portion of the councilman's report is appended with the single note in preface that the Rochester Electric Light company uses the United States system and that the areas of the two wards represent square acres:

Wards	GAS. Citizens	GAS. Municipal	GAS. Rochester	ELECTRIC. Brush	ELECTRIC. Rochester	ELECTRIC. Edison	Grand Total	Ward areas
1	...	1	19	39	...	..	59	85
2	...	..	36	27½	...	....	63½	135
3	....	7	177	16	...	....	200	280
4	75	..	...	22⅓	6	...	103⅓	100
5	167	..	...	47	1	....	215	625
6	12	...	...	32	...	...	44	115
7	127	...	...	21⅚	18	...	166⅚	310
8	...	195	162	21½	...	261	639½	870
9	...	...	113	71½	...	55	239½	700
10	129	5	...	30⅚	...	....	164⅚	310
11	...	..	75	30½	..	82	187½	335
12	166	..	..	13	39	....	218	550
13	86	27	...	25	...	...	138	275
14	38	...	..	40	..	....	78	206
15	..	..	..	381½	...	302	340½	1,883
16	136	...	...	401½	5	...	181½	3,926
	936	235	582	517	69	700	3,039	10,649

There is much in this table of interest. The appropriation for the lamp fund is $115,000. There are 1,753 gas and 1,286 electric, a total of 3,039 lights, and the average annual cost to the city is about $34 per lamp, gas, arc and incandescent. There is an average of one light to about every 3½ square acres or the city pays annually about $10 for the lighting of each square acre of territory. Rochester is a well lighted city and considering the amount of illumination the cost is low.

OUR French contemporary, *Electricité*, in an editorial note, takes up the subject of the tunnel under the English Channel, which the British government rejected after the work had been begun under the most favorable auspices, and with the highest assurance of its ultimate success. It is argued that the large amount of capital invested, and the large sums already expended in the opening of this gigantic work, must eventually lead to a favorable result; that the alleged fear of opening a road for military invasion is too ridiculous a pretext to be seriously entertained; and that great benefit must accrue to the English from such a connection with the continent of Europe, from which they are now isolated.

This enterprise is of importance to the electrical world, as it involves not only the lighting of the tunnel during the progress of the work, which evidently must be done by electricity, but, in all probability, the motive power for the trains will be electrical, since, in such a tunnel, the smoke and steam would render the ordinary steam locomotive impractical.

IN our columns this week will be found papers on apparatus for ocean cable transmission by Charles Cuttriss and Thos. D. Lockwood, read before a combined meeting of the American Institute of Electrical Engineers and the New York Electrical society in New York, on the 15th, with a report of the discussion which followed.

It is well known to most of our readers that apparatus suitable for telegraphic transmission over land lines can not be used with ocean cables, which from conditions peculiar to them require apparatus of the greatest delicacy and sensitiveness. The mirror galvanometer of Sir William Thomson is just such an instrument, and for some years was the only one in use and did excellent work. It consists of a delicately poised galvanometer needle, sensitive to the slightest shade of current, to the center of which is attached a small mirror which reflects a ray of light from a lamp on a screen suitably placed; the ray acting as a long pointer, so that the slightest deflection of the needle, scarcely perceptible to the eye, is multiplied by this long ray, moving without friction, and dictates on the screen a distinct movement to the right or left of a given line. The difference of amplitude given to these movements and combinations of movements by the operator at the distant station constitutes the visible alphabet, read by the eye, as the click of the ordinary instrument is read by the ear. This, as explained by Mr. Cuttriss, requires two receiving operators, one to write the message while the other reads and dictates it, since it would be impossible for the latter to write while watching the moving ray of light. The consequence is that mistakes occur from imperfect enunciation, which can not be corrected till after the message is completed, occasioning loss of time, which in this case is emphatically money. These defects showed the necessity of a more efficient instrument, and the siphon recorder, also by Sir William Thomson was the result, by which ink and paper oppositely charged by a static generator are brought into contact, the ink being ejected from a very fine siphon tube $\frac{1}{200}$ of an inch in diameter. The unreliability of the static generator in the damp, hot summer weather, led Mr. Cuttriss to seek for some means of improving this otherwise excellent instrument, and he naturally looked to magnetism for a solution of the problem, and after long, patient investigation, with the usual accidental discoveries incident to such investigation, he perfected the present magnetic syphon recorder, which accomplishes the work very perfectly and is free from the defects found in the electric instrument.

The use of submarine cables for telephonic transmission, which was the principal subject of Mr. Lockwood's paper, elicited a very earnest discussion, in which Mr. Cuttriss fully indorsed the opinion expressed by Mr. Lockwood, that such transmission is impossible over lines more than 100 miles in length, on account of the comparative slowness of electric movement over such lines; the impulses not being capable of moving the diaphragm of the telephone with sufficient rapidity to produce audible sound. The interest manifested however showed that the importance of the subject is fully appreciated, and we may hope that scientific invention will yet solve the problem as it has many a problem presenting similar apparent impossibilities.

Recent Improvements in Apparatus for Ocean Cabling. [1]

BY CHARLES CUTRISS.

In order that the improvements embodied in the instrument you may have seen at the American Institute Electrical exhibition may be clearly appreciated, it would be well perhaps, if I were to mention briefly the instruments previously used on the Atlantic and other long submarine cables.

The mirror galvanometer was undoubtedly the first commercially successful instrument ever used on an Atlantic cable, and you are all so familiar with it as a measuring instrument that a description will be superfluous, but perhaps it will be well to point out its defects as an instrument by which messages are received: First, it requires two operators to work it, one to call out the signals, the other to write them down. At a first glance there would not seem to be much room for errors on the part of the writer, as the operator is called who writes the message, letter for letter from the other's dictation, but you will see that they can easily be made when your attention has been drawn to the similarity in sound between B, P, V, M, N, and other letters when rapidly called out. This similarity of course depends largely upon the more or less clear enunciation of the speaker. The liability to misunderstand a letter on the part of the writer tells severely against the rapidity of the service as well as its accuracy, for this reason; supposing the writer misses a letter in a code message, he has no possible way of telling from the context what it should be, can not interrupt the receiver to ask him to repeat it, therefore his only course is to omit it and trust to his reader's recollection of the particular word at the end of the message. If he should not remember it, they must then delay the traffic by getting the word repeated from the distant station.

In order to avoid this liability to misunderstand one another, some operators got into the way of calling out the letter and immediately following it with some short word whose initial letter would correspond with the one called out, such as "n" for "nuts," "m" for "mutton," etc.

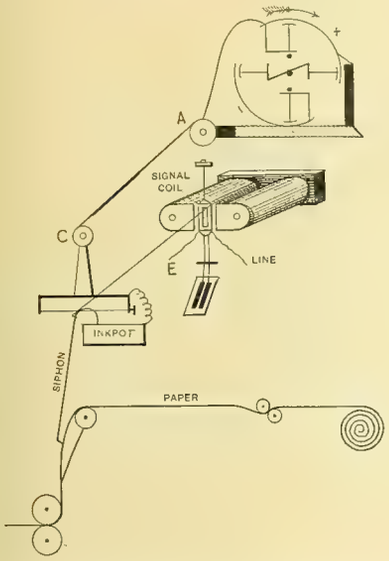

FIG. 1.

Another cause for delay arose from the fact that some readers would never trust to the correctness of their writer, but would always stop at the end of a message to scan it over in order, if possible, to detect any error that might have been made. While all these things added to the delay in transmission, one can hardly blame the clerks; for if an error was discovered at headquarters it meant a fine of $\frac{1}{16}$, $\frac{1}{8}$ or $\frac{1}{4}$ of a day's pay, in which all three of the clerks—the transmitter, receiver and writer—had to participate. It was impossible to lay it at the door of any particular one, as each of them would most emphatically deny the soft impeachment of the possibility of his making an error.

These causes of delay are now obviated by the use of the recorder, as the operator can always take a second glance at any doubtful signal. Were it not for this liability to error on the part of the mirror clerks, I doubt if that instrument would have been so entirely superseded by the recorder, for its simplicity is a great recommendation. It requires very little skill in its adjustment, and with clerks that work well together, its speed is as great as, if not slightly greater than, that of the old form of recorder.

During the years 1868 and 1869, while I was in Sir William Thomson's laboratory in Glasgow university, his first siphon recorder was constructed. I well remember the instrument, the electro-magnet of which was a ring of iron about 1 foot in diameter, 1 inch thick and 6 inches deep. The signal coil was rectangular in shape, about 6½ inches long by 2 inches wide. The electro-motor for drawing the paper slip was an ordinary 5 or 7 armatured wheel with two electro-magnets. It was provided with two bands, one of which turned some wheelwork, which drew the paper slip, while the other rapidly revolved a small generator or replenisher which produced by induction static electricity for maintaining the electrification of the ink. This replenisher worked on the same principle as those used for maintaining the potential of the Leyden jar of Sir William's quadrant electrometer. The whole arrangement looked like a medley of different instruments selected at random from a laboratory supply; yet each had its different part to perform, and it was wonderful to see the results that were obtained, when they were working harmoniously together under the direction of the masterly mind of the man who organized them, and who stands peerless either as an inventor, a scientist or a patient instructor.

Some three years later one of the most improved recorders was sent out to the cable station at Duxbury, Mass., and as you may not be acquainted with its construction I will describe it briefly in order that you may more readily understand the changes that have been made in it up to the present time.

The upper part of the diagram, Fig 1, represents the "mouse mill," as it is commonly called, which generates the statice lectricity, which is conducted from the drum *a* containing a coiled spring along the moist string and thin wire which you see stretched from *a* to *c*; the ink pot is supported on a baked wood arm and is metallically connected with the frame to which the siphon is suspended, this in turn being connected with the milled nut *c*. *N* and *S*, Fig 2, are the respective poles of a strong electro or permanent magnet, between which is seen an oblong piece of soft iron, the purpose of which is to concentrate the magnetic lines of force into two fields, through which the two sides of the rectangular signal coil pass. The signal coil, which is connected to the cable, is suspended by fine silk cord, and care is taken that it hangs perfectly clear from all the iron of the magnetic circuit. Attached to the bottom of the signal coil will be seen two strong silk fibers which pass behind a brass bar, into which a series of shallow notches are cut. To the ends of the fibers are attached lead weights which slide in grooves that are tilted slightly out of the perpendicular, the lower ends being the nearest to the observer; by this arrangement the fibers pass at a slight angle partly around a serrated brass bar, and consequently are held secure from any lateral displacement in any one of the notches in which they may be placed. These weights and fibers hold the signal coil in the magnetic field and prevent its moving in any direction other than a circular one, with the suspension cord as an axis, and any movement in this direction is resisted by the two fibers supporting the lead weights, which tend constantly to keep the coil in the center of the magnetic fields, and therefore the movements of the coil are controlled almost entirely by these fibers.

The siphon is attached, as shown, to a brass frame, from the bent ends of which is stretched a fine brass wire kept under a constant strain by a curved spring at one end. To the other end of the spring is attached a milled nut by which the wire can be twisted so as to put a lateral strain on the siphon and its carrier. A small lug projects from this carrier and to it is attached the fiber the other end of which is fastened to one corner of the signal coil. The signal coil is now twisted slightly in a direction such as to draw the fiber, and with it the siphon, away from the observer. If now the milled head on the brass frame is turned so as to bring the end of the siphon again toward the observer and into the center of the paper slip which passes in front of its lower point, every motion of the signal coil must be followed by the siphon; and as the fiber is attached so near the strained brass wire the movements of the signal coil will be greatly multiplied.

The marking of the siphon is done as follows: The mouse-mill generates static electricity, which being conducted along the string and wire from *a* to *c* electrifies the ink contained in the ink pot; and as the ink pot is insulated, the only way that the electricity can escape is by means of the column of ink contained in the siphon. It does not discharge as is commonly supposed across the air space between the siphon point and the moving paper slip, but the electrified ink draws the siphon which contains it bodily toward the paper—which is slightly damp—until they touch, when the siphon is immediately discharged to earth, and by its elasticity flies back to its former position, by which time a sufficient charge of electricity has accumulated to again attract it to the paper. These movements to and from the face of the paper, which are termed the "vibration," take place at a speed determined by the natural rate of vibration of the siphon, and are generally between 80 and 100 per second; hence we can obtain a record of the potential of the cable as many as 80 times a second; and as these potentials are determined by the operator sending at the distant station, they constitute the signals at the receiving stations.

The arrangement adopted in this instrument to regulate the supply of static electricity to the ink pot was by interposing a piece of moist string between the string drum *a* and the milled head *c*. This string had a fine wire attached to one end, so that by turning the milled head in one direction the length of the moist string interposed between the two points could be varied and likewise the electric discharge to the ink pot.

This arrangement worked very well at Glasgow, where the atmosphere is to a great extent saturated with moisture; but in this country the string was soon dry, and then the ink would not be electrified, and consequently the record would fail. To remedy this defect I made use of the brush discharge by connecting an adjustable wire, provided with a sharp point, to the drum *a*, and a flat piece of brass to the milled head *c*. This was found to work perfectly, and that principle has been adopted in all electrified ink recorders made since that date. But we soon began to experience a greater trouble than the one before spoken of, and one that still exists in all recorders using static electricity as a means of vibrating the siphon; that is, the great difficulty experienced in generating a supply of static electricity during damp weather, and in keeping the arm that supports the ink pot dry. Everything will work beautifully in nice, fine weather, but during the moist, clammy dog days of August, and the foggy days that are liable to come on at most cable stations without a moment's warning—then it is that trouble of the most aggravating description falls upon us. Suddenly the record fails. Examination shows that the generator or supporting arm of the ink pot has got damp. Lamps are lighted and placed near the instrument, sometimes with a satisfactory effect, but oftentimes not. In the latter case there is nothing to do but to stop working the recorder and go over to the mirror instrument while the generator is being dismounted and thoroughly dried; but meanwhile valuable time has been lost, and business has been delayed.

Everything imaginable was tried in order to overcome this difficulty, but without success, and at last we realized that in order to make the instrument more reliable, we must find some way of obtaining a record without depending upon the electrification of the ink.

The first suggestion came from John Gott, the superintendent of the St. Pierre station, namely, to make the siphon a shade larger than usual, and put a few camel hairs in the tube at its marking point, and, as it were paint the record on the paper slip. This worked very well, but the siphons would occasionally clog up, as we were at that time using commercial writing ink. The hairs acting as a strainer would arrest the larger particles. When you realize the smallness of the tube, the bore of which is only 1-200 of an inch in diameter, the wonder is not that it got clogged up, but that the ink would flow through it at all. The next step in advance was taken one day when the hairs accidentally came out of a siphon, the point of which happened to be particularly smooth and square with the paper; it was then found that a very good and reliable record was made by carefully adjusting the paper up to the point of the siphon until it touched it. The paper was then drawn slightly backward again; the capillary attraction being sufficient to keep the siphon from leaving it, while at the same time the friction was greatly reduced. This manner of recording has been used ever since that day on the "Dy" section of the "69" cable, and it has also been adopted on many others whose length does not exceed 1,000 miles, but they must have a conductor of low resistance.

About the year 1876 I constructed a recorder of the most simple kind, in which the signal coil was pivoted and to which the siphon was directly attached. The controlling springs or fibres were dispensed with by attaching a small piece of iron to one corner of the coil and bringing it under the influence of another movable piece of iron on one of the pole pieces of the electro-magnet. It was during the construction of the instrument that I first endeavored to vibrate the siphon mechanically and also by means of magnetism, but at that time I did not succeed in getting a perfectly straight and steady line. As the mode of working before described was so satisfactory, I did not pursue my experiments any further, for inasmuch as I had

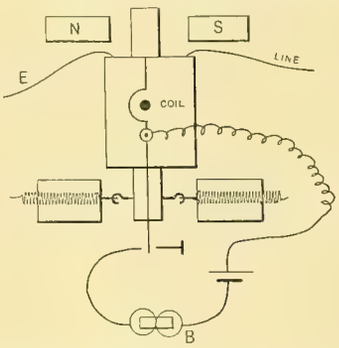

FIG. 2.

eliminated the troubles incident to the use of electrified ink at the Duxbury station, I did not realize that they still existed at other stations, where the methods we adopted could not be practiced, owing to the greater length of the cables. However Mr. Dickenson, of Heart's Content, N. F., was not idle, and during the year 1885 he invented and patented a method of vibrating the siphon mechanically. The method practiced by him was to prolong the cradle carrying the siphon. He then attached a magnet and armature at the end of the frame carrying the strained wire, and connected the prolongation of the cradle to the armature by a silk fiber. When a battery is connected to the magnet and its circuit is rapidly interrupted, the motion of the armature is communicated to the siphon by means of the connecting fiber. What success this invention has met with in practice I am unable to state.

When I became identified with the Commercial Cable company, I found that it was decided to prolong their ocean cable, which landed at Coney Island, into the heart of the city by means of an underground cable, and to use a recording instrument upon it The type of cable and the high rate of speed at which it was to be worked required that the instrument should be of the most sensitive class, hence electrification of the ink or some other device for preventing friction between the siphon and the paper slip must be used. Therefore, as nothing else offered, we adopted the electrified ink recorder. It was not long before the old troubles were encountered, as the office was very small, and we were obliged to keep the windows open for ventilation. Consequently it would be only a short time after a rain storm began before I heard the old cry, "the ink has failed." This was such a constant source of trouble that I determined to try again and find some other way of vibrating the siphon After mature thought, and with the experience gained from previous failures, I was convinced that, in order to make any device work successfully and still leave the instrument as sensitive as by the use of electrified ink, the siphon must hang perfectly free and not be retarded in its lateral movements by any extraneous fibers, and that, at the instant it touched the paper to leave its dot of ink, the point must be locked, as it were, to prevent its re-bounding laterally, in case the surface of the paper should be slightly irregular. The only resource seemed to be magnetism applied as nearly as possible in the same manner as had previously been practiced with electricity. I determined therefore that the part of the siphon under its influence must be the marking point. The question then arose in my mind as to the possibility of attaching a sufficiently

[1] Read before the New York Electrical Society and the American Institute of Electrical Engineers, Nov. 15, 1887.

large piece of iron to the end of the siphon without weighting it to a degree that would be detrimental to the clearness of the signals, by reason of its increased inertia. Another very doubtful point was, would it be possible to construct a magnet with a field of force so uniform that a siphon tipped with iron would vibrate at right angles to the plane of its polar face without any tendency to irregular lateral movements, or in other words, if it were placed near the edge of the magnet, would it not have a tendency to be drawn toward the center? When the idea was first conceived, I must admit that I had the greatest doubts of its success. But nevertheless I determined to give it a trial, so I attached a toothed wheel to the shaft of an electro-motor, so as to act as a contact breaker for the local circuit, containing the electro-magnet with which it was desired to vibrate the siphon which had its point armed with a small piece of iron, and was attached to the usual strained wire suspension of a recorder held firmly in a vise on the same table upon which the motor was running. The siphon was now approached by the rapidly vitalized electro-magnet, but without its showing any signs of vibration. Thinking that perhaps the battery was not strong enough to energize the electro-magnet sufficiently, more was added to the circuit, but still without effect. The electro-magnet was then removed, intending to replace it with a more powerful one, but the motor was still running. So imagine my surprise the next time I looked toward the table when I saw the siphon vibrating beautifully, describing an arc of about half an inch.

Thus without any apparent cause it was doing of itself what I had vainly endeavored to make it do with a powerful electro-magnet. However, the solution of the mystery was soon arrived at, as I accidentally touched the table and felt a very slight but regular vibration; then everything was clear and I saw that the motor put the table into a state of vibration, the rate of which was exactly equal to that of the natural rate of the siphon; which, therefore, picked up the vibrations and showed them in a greatly magnified form. I realized plainly from this experiment that to make the siphon vibrate by magnetism all that was necessary was to vitalize the magnet at a rate equal to the natural period of the siphon. In a short time by means of a second experiment I succeeded in producing these vibrations by magnetism and found them just as regular at the edge as at the center of the magnet, the siphon not having the slightest tendency to move laterally from any position in which it was placed.

It would be uninteresting to you to follow me through all the numerous experiments that were made before the vibrator was perfected. But I will mention one instance that shows how simple may be the cure for the unforseen difficulties that constantly arise when one is trying to perfect an instrument. When the first vibrator was tried, in which mercury was used to alter its rate, it was noticed that the record would fail with great regularity for about an inch. The trouble was located in a glass tube, and was due to some of the mercury climbing up it under the influence of the vibration and then falling back to the main body. This, of course, made variations in the rate, and was fatal to the instrument unless it could be remedied. I tried to put weights on the top of the mercury, but they would not work satisfactorily, and at last, when almost in despair, the remedy was found in two drops of glycerine. The viscosity of the glycerine, I find, is so great that it prevents the column of mercury breaking up.

This method of vibrating the siphon by magnetism has been applied to all the Thomson recorders in use on the Commercial Cable company's system for upwards of a year with the greatest success. Failures of the ink now are a thing almost unheard of, and the recorder, so far as ink failures are concerned, could, if necessary, be worked under a shed during a rainstorm or fog, as well as though it were in a warm room.

In all the Thomson recorders that I have seen, the movements of the signal coil are controlled by the lead weights before spoken of, and the clearness of definition and shape of the signals depend almost entirely upon the adjustment of the fibers which are attached to the signal coil and support these weights. In practice more or less trouble is found in maintaining such an adjustment as will give the best shaped signal. This is owing to the dust which collects upon the weights, wedging them fast in the grooves. Consequently any change of temperature, or humidity of the air, will alter the tension on one or both of the fibers, and thus oftentimes render the signals unreadable. So much trouble was experienced from this cause at our Canso station that it led the superintendent, S. S. Dickinson, who was ably seconded by J. C. Upham, the mechanician, to devise an adjustment in which the weights were discarded and a spring used in their place. The fibers could also be spread to any desired extent, and as the strain on both of them was exactly the same, the signal coil was always in a truly central position in the magnetic field.

Since this improvement has been applied to the instruments the adjustment has rarely been changed, and, what is of still greater value, a decided increase of speed has been effected. With the exception of these recorders, it is always necessary to stop work when it is desired to make any change in the adjustment of the controlling fibers, as they are very inaccessible. This, together with their occasionally breaking, led me to try and construct an instrument in which these difficulties would be removed. The result has been the instrument now on exhibition at the American Institute exhibition. [Fig. 3.]

The siphon *P* is a fine glass tube about one-hundredth of an inch diameter, one end of which writes upon the paper slip *J* and has attached to its point a piece of number 30 iron wire about one-eighth of an inch long, which serves as an armature and is controlled by the impulses of the magnetic table *T* over which the paper slip passes. The impulses of the magnetic table are controlled by the vibrator, which is placed on the large permanent magnets *M M*, and consists of a glass tube *W* which is connected by a tube of india rubber to the mercury reservoir *X*. The glass tube is supported by a steel rod carrying a spring contact point *V*, and carries an armature, seen opposite the poles of the small electro-magnet *Z*. When a battery of three or four gravity cells is connected to the terminals 1 and 4, the glass commences to vibrate at a rate determined by the height of the column of mercury in the glass tube *W*, the height of which can be regulated by turning the milled thumb-screw at the top of the mercury reservoir which connects with a plunger within the latter.

From the terminals 2 and 3, two wires connect to the electro-magnet of the magnetic table *T*. Thus every time the contacts at *V* are closed the table is energized and the siphon is drawn down to the face of the paper by the attraction of the magnetic table for the small piece of iron which is attached to the point of the siphon. If the impulses given to the siphon are in accordance with its natural rate of vibration a succession of fine dots of ink will be left on the paper in a perfectly straight line so long as the siphon is not removed laterally by the coil *R* and a supply of ink is maintained in the ink pot *Q*. Should the impulses given to the siphon by the vibrator not be in accordance with the natural rate of vibration of the siphon, it will not vibrate and the record will fail. But by manipulating the plunger in the tube *X*, the height of the column of mercury *W* is varied, so that the rate of the impulses can be maintained anywhere between 60 and 100 per second. Hence any siphon that would be suitable for the instrument can be controlled, as its rate will lie within these limits. When the proper height of the mercury has been once determined, which is generally found in less than half a minute, the siphon will continue to vibrate until it is broken or removed for other causes.

The signal coil *R*, which is moved by the currents transmitted from the distant station, is pivoted at the bottom and top *B* in agate bearings, and is free to move in the annular space between the poles of the permanent magnet *M*. On the top of the coil there is attached an aluminum extension *E*, which has a narrow slot at its upper end

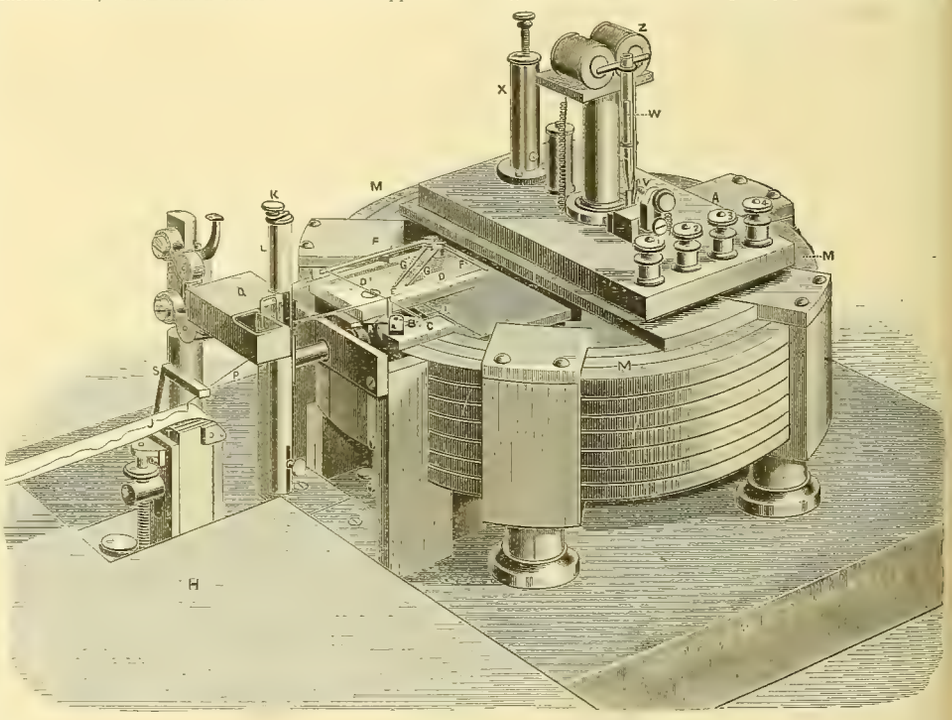

Fig. 3.

through which passes the regulating fiber *D'*, one end of which is attached to a rigid support *O*, the other end being fastened to a flexible spring *F*. The strain on this spring and this fiber is regulated by moving the index *G'*, and the strain thus produced controls the movements of the signal coil *R*. Close to the point *E* and at right angle to the fiber *L'*, there is another fiber *D*, one end of which is attached to an exceedingly delicate spring *F*, the other end is fastened to an extension from a fine brass wire contained in the tube *L* to which the siphon is secured. The upper end of this strained wire is attached to the thumb-screw *K*, so that by turning the latter the siphon can be moved laterally over the face of the paper to any required position.

Thus it will be seen that if the siphon is moved off the paper slip toward the front of the instrument when the fiber *D* is strained by moving the spring *F* outwardly, the siphon can be pulled by it into a position over the center of the paper; the torsion on the strained wire and the strain on the spring now balance each other, and if the two cross fibers are fastened together at a point as near as possible to the extension *E*, any movement of the coil will be multiplied and transmitted by means of the fiber *D* to the siphon. By lifting the fibers out of the slot *E* and turning the coil toward the front of the instrument, the coil and part of the pole piece *C* can be removed from the instrument without disturbing any other part, and, when replaced, no re-adjustment will be necessary.

It has been suggested to me that pivoting the coil was a step backward, as it introduced friction, and would mar the definiteness of the signals. I can only say, in reply, that when the instrument is adjusted, and giving good signals at a rate of 30 words per minute, I cannot detect the slightest friction. If I deflect the siphon laterally only the width of a hair it immediately, on its release returns accurately to zero, which it certainly would not do if there was any friction worth speaking of in the pivots.

I have received good signals on this instrument at a speed of 30 five letter words per minute, over our New York Canso cable, which has a length of 980 miles, capacity of 231 microfarads and copper resistance of 13,680 ohms.

I do not intend to stop at this speed, but think that with the next instrument, in which some of the parts will be slightly modified, a speed of 25 or 26 code words a minute will be attained over our long sections, which have a length of 2,740 miles, capacity 874 microfarads and copper resistance 6,967 ohms.

I will not take up much more of your time this evening, but as the title of this paper is so broad I am loth to leave the subject without mentioning the great advance that has been made during the last few years in the working of the Morse system on cables,

Before the year 1879 no section of the Atlantic cables had been worked by any other method than mirror or recorder. That the Morse has been successfully introduced on two sections is due to the determination and persistance of G. G. Ward, of this city, at whose request T. J. Wilmont, now superintendent at Waterville, Ireland, applied himself day and night to the task of originating a translating device by which, in the year 1879, Torbay, in Nova Scotia, was put in direct communication with New York.

This same device, in which the Allan & Brown relay is used as a receiving instrument on the cable circuit, is now worked on our Rockport and "Cs." section. The difficulties that were surmounted will be better appreciated when I mention that the length of the cable in circuit is 610 miles, with an inductive capacity of 168 mfds., and a C. R. of 8,482 ohms. The total circuit, inclusive of the land line, is 942 miles.

The Allan & Brown relay consists of a coil through which passes a soft iron core. The ends of the core project into the magnetic field produced by the permanent magnets *N S* and are consequently polarized by them. In the diagram, the mark in the center of the rectangle represents the axis of the coil. If, now, we connect the coil to the cable circuit and have two fixed contact points for the local circuit, as in an ordinary relay, the first impulse, of say the letter "S," which consists of three dots, will close the local circuit; but as the cable does not lose its charge rapidly, as is the case with a land line, the coil will not return to the back-stop and be ready to close the circuit again with the second impulse of the letter, but will be held fast to the front contract, keeping the sounder closed all the time. This, of course, will prevent any more signals being received over a cable, and some means had to be found by which the armature tongue would open the circuit whenever the potential of the cable fell ever so slightly from its maximum. This was accomplished by allowing the armature tongue, which is called the "jockey," to have a movement around an axis of its own. It was therefore pivoted, as shown, slightly in advance of the axis of the coil; you will now see that if the two points which control the local circuit are adjusted very closely together, allowing the end of the jockey a play of only $\frac{1}{1000}$ of an inch, every time that the coil falls back towards its center position (after having been deflected by the receiving current) only $\frac{1}{1000}$ of an inch, the local circuit will be opened, and *vice versa* any increase in the potential sufficient to move the coil the same amount will again close the local circuit. By this means the coil is moved sometimes considerably in one direction, and although by watching it very closely no backward movement can be detected, the jockey will open the circuit, sometimes two or three times, proving that there have been corresponding falls in potential. On the axis of the "jockey" is a very delicate spring which can be pressed down by a small nut so that just sufficient friction is maintained on its jockey to enable it to close the circuit firmly enough to pass the signals to the local circuit.

Some few changes have been made in the jockey of the relay by the superintendents at the terminal cable stations—Mr. Dickinson at "Cs" and R. Hearn at Rockport—

until at last such perfection has been arrived at that the signals are passed from Canso to New York in such a perfect manner that none but an expert could tell that there was any cable in the circuit. This is, I believe, the longest section of cable on which the Morse system is worked and, although repeated efforts have been made to attain the same results on a cable only about 100 miles longer, the retardation was so severe that the speed attained was too low to allow this system to be adopted.

Gentlemen, I thank you for the patience with which you have listened to me this evening and I regret that time will not allow me to touch on several other interesting branches of investigation, such as curb sending, the duplex, automatic transmission, etc. But the object of this paper will have been attained if you realize that, although seldom heard from, there are many patient investigators in our remote cable stations and that to their unflagging energy is due the fact that we are now easily able to handle a bulk of business that would have staggered us a few years ago, and do it with so little delay that a message can be sent from New York and delivered in London in less time than you can send one from down town to Harlem.

NOTE ON THE SIPHON RECORDER AND OCEAN TELEPHONY. BY T. D. LOCKWOOD.

As some of you are aware, I was present at the time and place appointed for our meeting, to hear Mr. Cuttriss explain and describe the improvements he has effected in the siphon recorder.

Although the unfortunate accident which we all deplore deprived us of the pleasure of hearing Mr. Cuttriss at that time, and myself perhaps for all time, still I congratulate myself that my visit to New York has at least given me a personal knowledge which I had never before possessed of that beautiful instrument, the siphon recorder. I have obtained a new illustration of the impossibility of obtaining an accurate knowledge of the construction and operation of a delicate piece of electrical apparatus from text books. I had studied the siphon recorder in books, but found myself ignorant of it when the opportunity of examination at length presented itself.

It was especially gratifying to me to learn that we were to hear about an important branch of telegraphy, for I think that telegraphy has been of late neglected.

Though I yield to no man in my admiration for the immense recent amplification of the work of electricity, or in my appreciation of motors, lighting apparatus and heavy currents, I love variety, and have found it somewhat palling to read and hear as much about them as I have had to of late; for just as the human stomach quails at the idea of eating quail more than forty meals in succession, so the human mind revolts at the notion of considering electrical currents due to an e. m. f. of 600 to 1,000 volts perpetually, and longs to demi-volt once in a while. Therefore I hail with joy the announcement that we were to hear about the siphon recorder.

I learned that Mr. Cuttriss' recorder was operated by a permanent magnet instead of an electro-magnet. That is an advance which appeals strongly to me; and it means, as I look at it, a considerable diminution in the amount of attendance required. When I consider the number of telephones in use now, and reflect what a number of cells of battery would have been reqnired had it not been discovered that permanent magnets could be utilized, and that the use of the battery was chiefly to make the magnetism, I can not but appreciate that this is a material advance step.

Then let us look a little further; I understand from the text books that on long cables it was found that if the siphon end were allowed to touch the paper, the freedom of its movements was interfered with, and that it was therefore found necessary to oppositely electrify the ink and the paper, the former being thus caused to issue and to mark the paper in a succession of fine dots.

If I understand the instrument of Mr. Cuttriss, it dispenses with this feature, which must have often marred the usefulness of the recorder, since on our eastern coast the atmosphere is usually rather "hygroscopic." I can well imagine occasions when all the ability of the operators and electricians must have been called into play to get the electrifying machine—the "mouse-mill," I believe, to work—in places and at times when the air was surcharged with moisture, and the "relative humidity," as the signal service calls it, was up in the nineties per cent.

It is interesting to note with Prescott, that while the telegraph of the United States, the Morse, which made its proud boast that it was a recorder; and by the way the first recorder, has now almost totally been transformed into an acoustic or aural transient signal, the Cook and Wheatstone telegraphic idea, the visual semaphore, has evolved into the wonderfully delicate recorder before us.

I am also desirous of calling the attention of the Institute to the fact recorded in a letter of John Gott, dated St. Pierre, Miquelon, March 24, 1887, to the Society of Telegraph Engineers, that the siphon recorder was capable of transmitting and reproducing speech telephonically, and that Mr. Gott had actually used it as a telephone. As I think this circumstance deserves a wider recognition, I will quote certain portions of the communication.

Mr. Gott says: "With the object of stimulating inquiry into the means of improving the telephone of Mr. Bell, which is the most beautiful adaptation of telegraphy ever made, I desire to draw attention to a few simple methods by which any one may satisfy himself of its practicability, for no one having witnessed its performance can fail to see a great future before it. The recorder of Sir William Thomson affords a ready means of speaking and gives out such clear tones as to make the listener at first involtarily look for the speaker behind the instrument (who may be miles away). It suffices to take a tube two inches in diameter, and stretch over one end a membrane of parchment or thin gutta-percha (the latter is less affected by the breath, the former becoming somewhat flaccid after a time). To the center of the membrane cement a straw, and fix the tube in front of the instrument; about six inches from the movable coil cement the other end of the straw to the coil at the point where the silk fibre is usually fixed; this is all that is necessary for both speaking and receiving. Six or eight cells on the electro-magnets suffice.

"A pair of these tubes may also be connected by a similar manner with the tongues of the two polarezed relays The tube is to be fixed in a convenient position at right angles to the tongue, taking care that the latter is free from its ordinary contact points. No battery is required for speaking with this arrangement. Or a pair of these speaking tubes may be connected with the ordinary armatures of any instrument or relay, and a current kept on the line.

"By these simple means may be demonstrated the possibility of speaking over many miles of telegraph line. The sound in the tube is not that of a whisper but of a voice at a distance; I have spoken through four knots of buried cable without sensible diminution of effect."

Since writing the foregoing it has been suggested to me that I might say a few words on the possibility, or possible practicability, of telephonic transmission over long submarine cables.

There is, I think, little to say on this head. You are all aware that in telegraphy it has been found possible to clear cables of charge by sending after each impulse of definite direction a clearing impulse of opposite direction by which the static charge of the conductor was neutralized and the line cleared for the transmission of a second signal.

The first idea regarding the transmission of telephonic or voice currents over submarine cables is in favor of its praticability; for it may be argued, since the foregoing practice aids the transmisson of telegraphic signals, and since telephonic currents, as usually transmitted, consist of a series of rapid alternations, why have we not here just the conditions of success.

The truth is we have not. For in telephony the changes occurring are infinitely too rapid. They cannot serve the purpose of clearing the line; they rather serve the purpose of blocking the line, for the successive and consecutive impulses of opposing direction succeed one another so swiftly that they practically neutralize one another

Take, for example, the magneto telephone. It is well known that the currents generated by this instrument when used as a transmitter are alternating, and follow one another with extreme rapidity; so that for a long time it was thought that they were so infinitesimal as to be immeasurable.

Suppose we have a fine galvanometer, and telephone through it. We see no deflection, not because the current is so small, but because the plus currents succeed the minus currents of like potential and strength so fast that the needle cannot respond, and therefore does the next best thing and stays at zero.

Let us now consider the battery transmiter and induction coil. A moment's consideration will show us that we have a close analogue to the operation of the magneto telephone.

For though it is true that in the battery transmiter the action of the diaphragm merely varies the resistance of the circuit, and consequently the ratio, yet it is none the less true that the use of the induction coil develops currents in the secondary circuit and line which are alternating, because caused by the successive rise and fall of current in the primary circuit.

Consequently these currents are subject for long circuits of high capacity to the same drawbacks as those of the magneto telephone. We have then at present only one other alternative method, namely, the plan of including the battery and transmitter in the main line, and allowing the transmitter to vary a permanent current flowing in the main line, thus dispensing altogether with the coil But this also is impracticable, because the very small proportion of variation in the total resistance of such a circuit cannot develop fluctuations of sufficient strength to satisfactorily influence a receiving instrument.

I am therefore convinced that electric telephony—that is the transmission and reproduction of the human voice—will not, at least in the near future, be possible over long cables.

Electro-static induction and the retardation and prolongation resulting therefrom is the reason.

When I say long cables, I mean, for example, those over 100 miles long; and it would be difficult and not commercially successful over much shorter distances.

My conviction is that those who advertise the operation of telephones over Atlantic cables, either do not know what they are talking about, or, knowing, wilfully make misstatements for personal prospective gain. I am very sorry that I cannot be present to hear Mr. Cuttriss, and the discussion of the subject, but will certainly enjoy reading it afterwards.

Previous to the reading of the foregoing papers, suitable resolutions of regret at the sad death of Sidney F. Shelbourne were read and adopted. After the papers were presented, President Martin announced that discussion was in order.

MR. WETZLER: I would like to hear from Mr. Cuttriss as to what his experience has been in telephoning over cables.

MR. CUTTRISS: My experience in trying to telephone over cables commenced, I think, the same year, or at any rate the year after the telephone was brought out by Professor Bell. I was then at Duxbury. The late Mr. Gower, whom I presume most of you know of, came down there with the best telephones made up to that date to try to speak over the Duxbury cable. He also brought down with him his electric harp, as he termed it, which was a series of reeds which could be struck by hammers the same as in a pianoforte, which would vibrate the contact points underneath the reeds and send, of course, the same number of vibrations into the line to which the reed was tuned; and it was his desire to put that on the cable and have the superintendent, Mr. Gott, at St. Pierre, listen at the telephone for any sounds. He evidently, at that early time, appreciated the fact that it would be easier to get an intermittent current over a cable than it would be to get speech over it. We listened and Mr. Gott reported nothing. He tried, varying his power to the limits to which we allowed him to go, but still Mr. Gott reported there was nothing. We then asked Mr. Gott at his end to send currents into the cable through condensers and also without condensers—intermittent currents. These were from a key. Nothing was heard; it was absolute death in the telephone. Mr. Gower would not believe, nor could we convince him, that the telephone was properly connected with the cable; so to prove it I connected his telephone in circuit with the recorder and got the party at the other end to send regular telegraphic signals into the cable. By this means they would have to come through the telephone and on their way to earth also pass through the recorder. If the signals came we must see them. The consequence was, every signal came out written perfectly on the recorder, which we all read; but still it was death in the telephone—not a symptom of a sound. Still Mr. Gower was doubtful and I did not know what to do. He did not like to doubt us, and yet we could see that he was doubtful. At last it struck me that I would put a rapid rheotome in the circuit with the telephone. Now, if there was any current coming over the cable at all, although it was infinitely weak when it was received at the receiving station, this rapid make and break would vary it so much as to make it audible certainly in a telephone. The next time the signals were transmitted over the cable, the make and break being started, the room was filled with the sound of the pitch of the note that the make and break took, showing that the cable current was all the time passing through the telephone; but its wave was so slow and so even that although the diaphragm responded to every one it was totally beneath the capacity of any human ear to take the waves up and hear them as sound. Of course, you will all readily understand that not sending more than probably 100 signals in the circuit at the time, the vibrations coming in waves of that period would not be audible, because no ear can take up sound at that rate. That has been my experience. We have tried it over our cables here in New York for several parties, and we have also conducted experiments for Professor Farmer, within the last year, over our Rockport cable, to see if we could get any sounds in that way. But in every case it is absolute death, and the most that I have heard signals on a telephone has been through about 75 miles of artificial cable. That has been the maximum.

The president called upon Captain Trott, of the cable repairing steamer, Minia, which happened to be in port at the time saying in his introduction, "Captain Trott is a very reticent man, but if we could once get him started he would give us such a wealth of information that it would take a good deal of time to digest it. Captain Trott, it will afford us extreme pleasure to hear from you this evening."

CAPTAIN TROTT: Mr. Martin has intimated that Captain Trott is rather reticent. That is not altogether Captain Trott's fault. We belong to an old telegraph company, the oldest Atlantic company. We represent the first Atlantic Cable company—that is the Anglo-American. I am its representative here with you, and as such it is hardly open to me to say all that I know of submarine telegraphy. The branch of it before you here to-night is not a part of my subject. It belongs to the electrical part of it. My special duty is to lay and repair. I was connected first with the direct cable. I was in command of the ship on the laying of that cable and also the French cable; but now those gentlemen who were with us then are in opposition to us. We are friends just the same, but I hardly think it right that we should give them all that we still have, when they are fighting us.

As you will have inferred from the description of the recorder here to night, submarine telegraphy is rather a dry subject, except our branch of it, which is very wet sometimes. I do not know that I could interest you much. It would take too long to go into all the details of our work. They are very difficult at times and at other times we consider them tolerably easy. Of course, as you know, we have to do the fishing for these things at the bottom of the ocean, and we have played our part at that, and no matter what the gentlemen present may think of that branch of electricity, I am quite sure you will all admit they can not do without it If we stopped the Atlantic cables, why some considerable business would stop. Therefore you are to some extent, depending on the telegraph cables. I thank you for the kind notice you have taken of me, and I beg you will excuse me from going into the matter of the operations, because it would take too long. I could not deal with it in such a manner, in the short time before us, as to make it anything like interesting. If any of you choose to come on board my ship which is in the dry dock at the Erie basin, we can show you some things there that perhaps you would be interested in. We have no secrets. We are prepared to show anything that we have there. There has been a great mystery made sometimes of submarine telegraphy, I think a little too much—that only certain individuals should know anything about it. We look upon it as a thing that is pretty well known to-day, and therefore we have nothing, so far as we are concerned, either as a ship or a company, but what we are quite willing the world should look at

I perhaps might say one word on the question of telephoning on submarine cables. My chief engineer is not here, but two of his assistants are present. They may remember. They were not with us at the time, but I dare say they may know something about it. We did once put a telephone to the cable, I think 83 miles from shore, and spoke through it and got conversation back. I think that is the utmost which was done. We have had singing through the cable at much greater distance and they could tell on shore the songs that were sung on the ship, but there was nothing in the shape of conversation, I think, beyond that distance, to my knowledge.

A MEMBER: How deep can you grapple a cable.

CAPTAIN TROTT: To the bottom, sir! [Laughter]; 2600 fathoms is the deepest water that I have worked in.

R. W. POPE: We understood from Mr. Cuttriss that we were indebted to Mr. Ward for the progress made in introducing Morse on the cables. A great proportion of American electricians know something about Morse and, of course, they are interested in knowing just what there has been done and what more there is a prospect of doing, and I presume that that point will be welcome if Mr. Ward could give us any further information upon it. I should for one be very glad to hear from him.

MR. WARD: Mr. Cuttriss has told you how far we have gone. We are working Morse on the Rockport cable. It was tried on the cable between St. Pierre and Cape Cod, but we found we could get no good results from it and it was abandoned. Since then nothing has been done on it, and the best results that have been obtained are, I believe, on this Rockport cable of ours between Canso and Rockport.

A MEMBER: Would not Mr. Cuttriss kindly tell us something of the vibrator invented by Mr. Prescott that has been in use for several years past.

MR. CUTTRISS: In reply to that I would state that I can not say anything about that vibrator. I have never seen it, nor have I seen any drawing of the method. I have heard that he does it by vibrating the whole coil under the siphon of a small Thomson recorder in which the siphon is attached to the coil. He vibrates the whole thing so that he lifts the siphon a small distance off the surface of the paper. That, I believe, is what his invention is. Whether he has made any other improvement since I heard of that I don't know. I know that there is a counter-claim between him and Mr. Dickinson. As to which is right in the matter I have no knowledge, and consequently I should not want to take any ground one way or the other. The method is the same as Mr. Dickinson's practically, with the exception that Prescott vibrates the whole coil and Dickinson merely vibrates the siphon by pulling it with the paper.

MR. WARD: With regard to the Morse, I should like to say that the relay is the invention of an American gentleman. You said that the Britishers were taking the steam out of the Americans in the cables; but this Allen & Brown relay was invented by a Mr. Brown formerly associated with Mr. Edison in his automatic system. Mr. Allen is the financial part of the invention, sir. [Laughter.] So the Britishers won't take credit for that.

MR. WHEELER: I think this question of telephoning through cables is so important that it ought not be passed over so lightly and I would like to ask Mr. Cuttriss to tell us something about what can be done to overcome the induction. I mean, has the effect of a complete metallic circuit been tried, and have there been any induction devices used?

MR. CUTTRISS: That is a hard one. Until you can change the nature of a cable I don't think there is much hope of doing anything. Of course, metallic circuits have been tried. I do not know that you gain anything by them. In fact, if the two circuits are parallel for any distance I think that you would probably lose by them, for you are getting this whole reaction between the two parallel wires; that would act the same as a condenser, and there I must say that, once speaking over this matter with Mr. Edison he told me that he did not believe that it would be possible for us to speak from the corner of Wall street down to the Coney island hut through our underground cable for that very reason. He said he thought all the current would be neutralized, so to speak, or short-circuited probably would be the better term, before it got down to Water street. In that he was wrong. I have spoken from Wall street down to Coney island very recently, and in one case where we had to open our cables to search for some trouble, at Flatbush, not half-way to Coney island, I spoke from the office to Flatbush direct, quite easily; but found that when I went, after concluding my test through that part and had previously instructed them to go on to the other end of the circuit, which was looped through our Coney island hut back to New York, so that we we went through three times the circuit, part of which was laid double and parallel, it was as much as I could do to hear the voices. Whether that arose from any action between the two cores, or what it was due to, I have not been able to determine, nor have I had any chances for pursuing experiments in that line. But I do not think that with long cables, a metallic circuit is going to be of any help. Of course, a great deal depends upon where your circuit is. If you are in a straight away country road, then I should say, as I before stated, that I think the straight line is the better; but if you are coming over the Brooklyn bridge, then I should say you are going to do better to come in a metallic circuit. Otherwise you get no speech at all on account of the induction of the other wires in passing over.

MR. WHEELER: Are we to understand from that, that a double wire would overcome the difficulty caused by the static capacity of the cable but would bring up a greater difficulty, namely self-induction between the two limbs of the circuit?

MR. CUTTRISS: I cannot say that I think the double circuit is going to overcome the static capacity at all. It cannot do it. The static capacity is still there. You would reduce your static capacity by using the two, to about one-half. But at the same time you are doubling the resistance. Of course with a telephone, that would not amount to much, because it would go through the resistance very easily, but it would bring somewhat this effect of short-circuiting across, the same as trying to talk through two parallel plates of a condenser. Of course this is all conjecture on my part, not having had a chance to try it. I think you would get no gain by working over a good road clear of outside induction—you would get no gain by working in metallic circuit. I think a straight away line would be as good.

MR. POPE: If I understand the gentleman correctly, the capacity of the recorders as now operated is such that it does not appear to me that anything is to be gained by telephoning over a cable, excepting as a matter of experiment; that is, unless the telephone system was a great deal better than our local service. I would much prefer a siphon recorder for accuracy in the transmission business. [Laughter.]

MR. CUTTRISS. On that point probably I could give a little light. The same day that Mr. Gower came down to Duxbury to try his electric harp he stated what a wonderfully beautiful thing this was going to be, to speak across the ocean. Well, having that trouble with the mirror between M, and N, P, and B and other letters, we rather doubted it, but we thought we would put the thing to a trial. So he went up stairs with one telephone, and we had the smartest of our clerks with a telephone down at the other end, and we took up what was then one of the most beautiful of cable messages—a stoker. If a man could make anything out of the word, of a stoker message, he could understand almost anything. We told him to speak that message through his telephone to the clerk down stairs who should write it down, and then the clerk should repeat it back to Mr. Gower, who should also correct it from the copy. I think if my memory serves me right, the message was something like a forty word message. The clerk down stairs got over eighty errors. It was repeated to Mr. Gower. There were two telephones in the circuit. Mr. Gower was listening at one and another gentleman at the other, and Mr. Gower corrected, as he supposed, forty of the errors; but there immediately arose a dispute between Mr. Gower and the other gentleman as to what certain letters were that were being sent. Now there were two people listening in the same circuit and yet they could not agree as to what one letter was. So long as a telephone will not speak more clearly than that through a room you can imagine what it will be through cable service on a long cable.

MR. POPE: That coincides with the early experience I had with the telephone. I was connected with the Western Union supply department and I had occasion to inquire of that department about the shipment of three or four carboys of acid to Charleston, South Carolina. I got along with the whole business until the man at the other end attempted to tell me the name of the schooner by which it was shipped. It was a simple name—Mary Jane or something of that kind. But of course there was no context to give me a clue as to what the words were. In other words to telephone successfully you must have an inkling of the business that is to be transacted and who the person is who is sending it. I have had occasion once in a while to answer the inquiry, "who is at the telephone," and before I could succeed in making them understand that my name was Pope I would get disgusted and give it up I presume that is one of the names that does not go through a telephone very well. That is one of the difficulties that I have always apprehended in connection with this proposition of telephoning commercial messages, and those who were most ardent in their advocacy of telephoning for commercial purposes were those who were not familiar with the facility with which a Morse operator can receive either proper nouns or cipher messages or anything of that kind, and the same would apply to cable messages. Of course the most of us understand that the bulk of the business transmitted over the cables is in cipher, and I doubt whether it would be possible to carry on the cable business as it is to-day with the best working telephone line there is in existence. That is my opinion of it.

MR. F. BENNETT: I understand Mr. Cuttriss to say that the diaphragm of the telephone responded to the undulations of the current, but not in rapid enough succession to be audible. Now, supposing this diaphragm had a needle on it, such as there is on the phonograph, and that the cylinder, like that of the phonograph, was to be rotated at a given speed, and the undulations of the diaphragm repeated on the tin foil of the phonograph, and after the message was sent let the cylinder be rotated at a more rapid pace, would it not cause the undulations of speech to be reproduced so rapidly as to be audible to the human ear?

MR. CUTTRISS: In reply I would say that it certainly would not be heard at the other end. There is no reason why the current from the phonograph should be any stronger than one from any intermediate source. The electrical harp that I speak of Mr. Gower's using was merely a rapidly interrupted circuit, according to any note that he struck. The harp contained about two octaves, and of course we had any range within these two octaves in which to try it, but no sound was got there at all, and in that he used, I think, four cells of LeClanché and a powerful induction coil, the current from which was strong enough to give you a very disagreeable shock. So you can see if that would not go, there would be no reason why anything from a phonograph would. It is exactly as Mr. Lockwood said in his paper: the currents are small and go with such infinite rapidity that they are neutralized before they get to the other end. They are actually swamped, and that is the reason that you cannot get anything through. The receiving currents, of course, came through his instrument, because they came slowly and were powerful enough to deflect his diaphragm. If we had a make and break on there it is possible we could have opened and broken the circuit from the diaphragm. Still, you can see why we could get no audible effect, for the moment we began to increase our speed sufficiently to bring it up to the point, we were sending the currents in so rapidly that they were beginning to neutralize one another, and before we could get to the audible rate they were neutralized—probably before they got twenty miles from the station.

MR. BENNETT: I think Mr. Cuttriss did not fully understand my meaning. We will take for illustration the old register where it makes the dots and dashes on the paper. Of course, we understand that that rotates at a given velocity, the same as it does in the phonograph. Now, supposing the cylinder on the phonograph was revolving the same as it does in the siphon recorder, it would cause the undulations, or the dots and dashes for instance, to make insertions in the tin foil, and then by revolving the cylinder faster it would cause sharper vibrations in the diaphragm and therefore cause it to be more audible.

MR. CUTTRISS: Certainly, that would be so. But what advantage would you get from getting a sound in that way, if it took you probably half an hour to get sufficient signals over the cable to move the diaphragm; that is, if it took you half an hour to get sufficient signals over the cable to be made audible through the diaphragm, by rotating the cylinder afterwards rapidly. I do not see what you would gain, because your signals would have to come very slowly to indent the tin foil at all, and you are certainly going to get no gain, because you can not send reversals, that is alternate, positive and negative currents. You can not send the same number of words over it per minute that you can by using what we term a mixed signal. The reversal has got to be a change to one polarity from another—a mixed signal, as we term it, the same as in letter S, where it goes up with the wave, all you need is that wave and the length of the wave to show that three signals have gone. Therefore, the sending of reversals through the cable does not increase speed.

MR. POPE: I would say before we close, that these questions that have come up in regard to what can and what can not be done over a cable, can be looked at, I presume, from two different points—from the experimental point and from the commercial point. As matters of experiment they may be very interesting; but commercially we must remember that the cable is a very expensive affair; its service is expensive and it is necessary to utilize every moment of time. Consequently, any system that is introduced must be an improvement in speed, or an improvement by reason of doing away with these detentions and faults in apparatus which Mr. Cuttriss has brought to our attention in describing the older forms of instruments. As I understand it the improvement has been in the continuity of the service rather than the speed that is doing away with detentions caused by repeating back signals and also by failures of the apparatus.

The meeting then adjourned.

CORRESPONDENCE.

New York Notes.

NEW YORK Nov. 19th.—The electric lights that for several years have shown from the high towers in Madison and Union squares will surely be missed. The groups of brilliants high in the air were a beautiful sight on dark nights, but the city does not pay for such luxuries, and as they were not wholly successful in lighting the parks they have had to go, and now are replaced by twenty-three lights on bright green poles distributed along the walks. The fault found with the light on the high towers was that they did not penetrate the thick foliage in the more remote parts of the Squares, where acts of disorder have been continually committed.

The city council at Philadelphia passed an ordinance Wednesday, granting the Bell Telephone company permission to lay its wires underground.

The first snow-storm of the season did considerable damage to Western Union wires along the line of the Harlem railroad from Chatham to Ghent. About five inches of snow fell, accompanied by a high wind.

A company has been organized at Rochester for the purpose of running street cars, to be operated by storage batteries, between that city and Charlotte. Charlotte is a summer resort at the mouth of the Genesee river, about seven miles distant.

Just about a year ago the telephone subscribers at Rochester, N. Y. went out on a strike, the occasion being the forcing upon them of a toll system, and they have since made a most plucky and persistent fight against the Bell Telephone company of Buffalo, which has resulted in practically killing the company's business in Rochester. Negotiations are now in progress between Colonel D. B. Parker, for the company, and a committee of citizens, which, it is hoped, will result in an amicable settlement. The present temper of the committee is shown by the following propositions, which were agreed upon at a meeting held on the afternoon of the 14th, and submitted to the Buffalo company for their consideration: First, the Bell Telephone company of Buffalo shall make such arrangements with the city authorities as shall be satisfactory—similar to those existing in Boston as stated by Colonel Parker; secondly, a flat rate, which shall be satisfactory to the People's Telephone committee, shall be established; thirdly, all subscribers who ceased to use the telephone in November, 1886, but whose contracts extended beyond that time, shall be released from liability; fourthly, those who paid in advance of Nov. 20, 1886, and who did not use the telephone after that date, shall be allowed the unexpired time on their new leases, provided they elect before January 1, 1888; fifthly, all litigation pending between the company and the citizens of Rochester and vicinity shall be discontinued, and the company shall pay all

expenses of the litigation including fees of counsel; sixthly, a person selected by the executive committee of the People's Telephone association shall be made a director of the Buffalo company, and he shall be managing director of the office and business at Rochester; he must be a resident of Rochester; seventhly, the company shall give a proper guaranty that the rates fixed upon as aforesaid shall not be raised for five years; eighthly, the wires to be placed under ground as soon as practicable, in the business streets.

Mr. Storke was again on the stand in New York, Monday of this week, continuing his testimony before the assembly investigating committee, this time as an officer of the Hudson River Telephone company. The relations of this company to the American Bell Telephone company are as follows: The Bell company own a controlling interest in the capital stock of $2,000,000, $700,000 of which they received in consideration of a perpetual franchise at the time of organization in 1883. In addition the Hudson River company pay them an annual rental of $14 per set of instruments, and 15 per cent. of the toll line business. The net earnings have averaged $56,372.40 per annum, an amount equal to less than 3 per cent. of the capital stock outstanding. Few local telephone companies are making much money, but this is worse than the average, and it is not surprising that the officers and shareholders of such a company, the greater part of whose earnings are going to Boston in the shape of dividends and royalties, should protest that such payments for privileges are too heavy a burden on their business. It is to be hoped that neither they nor their subscribers are expecting much relief from the state assembly. Exposing a "merciless monopoly" will never kill it, and the Boston corporation has been so often exposed by state investigations that it must be well toughened by this time.

The announcement that the American Institute fair will close on Saturday, December 3rd, is a reminder that this exhibition is an object of interest which should not be neglected. There is so much worth seeing, particularly in the electrical department, that the remainder of the closing days are important. A.

Detroit's Budget.

DETROIT, Nov. 19—The committee appointed to investigate the practicability of operating underground circuits, have reported their findings to the council. Their report is that an underground system is practicable, and the expense of constructing and maintaining it is not such as to preclude its adoption. The report, which was adopted, recommends that all companies be notified to remove their aerial lines which are within a radius of one mile from the city hall, on or before July 1st, 1888, and concludes: "That the city attorney and city counselor be instructed by resolution of the council to proceed at once to enforce the provisions of existing ordinances relative to overhead wires." Such a resolution was then introduced but was laid on the table.

Bay City now owns its own electric light plant of the Jenney system. The thirty days trial at the company's expense having shown it to be entirely satisfactory, the first instalment of $10,000 has been paid. The terms of the purchase were, one-third of the cost, $30,000 in cash; one-third in one year, the remainder in two years. The company accepted the bonds of the city, for the $20,000, at four per cent.

The Gamewell fire alarm system has been introduced into Ludington and Battle Creek. The company is also putting in a somewhat extensive system at Adrian, which it is expected will be in operation by December 1st.

The latest bid of the Brush company for the public lighting—the only one received—was opened by the comptroller Tuesday last. It differs but little from the previous one, which was noticed in these columns at the time. No mention is made of underground work, and a slight difference in regard to extra towers is conceded. The bid may be summarized as follows: Three years, $117,940; two years $120,215; one year, $123,463. The council will pass on the awarding of the contract, Tuesday next.

The truth of the adage, "every man to his trade," was forcibly illustrated at Port Huron the other night. Wm. Stapleton, a marble cutter, undertook to "fix" the electric light wires in Palace Hall, using a poker for the work. He hasn't found out yet what struck him, but when fully recovered, will probably follow his trade and eschew electricity. C.

THE ELECTRIC LIGHT.

The electric light is to be put in at Mancelona, Mich., shortly.

Last month General Pontus, the Belgian war minister, and several leading officers of the army witnessed at Antwerp, a trial of Bruce's system of transmitting military signals at night. The arrangement consists merely of putting incandescent lamps inside a small balloon which is allowed to float at a moderate height, and then flashing signals by means of a Morse key with carbon contacts. The signals were easily read at a distance of 3,000 metres.

Fred S. Hatch, W. R. Brown and Capt. Clark Gray have purchased a three-fifths interest in the Larned, Kan., Electric Light company for $21,000, cash. The officers of the reorganized company are: W. R. Brown, president; Allen Ditson, vice-president and general manager; Clark Gray, treasurer, Fred S. Hatch, secretary.

The General Company of Electricity of Berlin with a fully paid up capital of £250,000 has issued £350,000 of additional shares at a rate of 122 for 100. Forty thousand pounds worth was taken beforehand by Messrs. Siemens & Halske, and the rest is subscribed for several times over, all fully paid. The purpose is the working of central stations in Germany and other countries.

The construction of the electric light plant at Minneapolis, Kan., is progressing rapidly.

The Vienna Industrial museum has recently inaugurated a testing establishment. The charges follow: Dynamos, according to size and tests required, £1 10s. to £5; glow lamps, efficiency on photometer £1 to £5; glow lamps, candle power only £1; arc lamps, efficiency £1 10s. to £2; arc lamps, candle power only £1 10s.; measuring instruments 10s. to £2; arc lamp carbons £1; specific resistance tests £1; temperature coefficient tests 12 s.; general photometric investigations on various sources of light 6s. to £2. If the results are to be published a further payment is to be made to the funds of the institute.

THE ELECTRIC MOTOR.

The Cincinnati *Artizan* now prints by means of an electric motor.

The Euphrat Electric Railway Cable company has established its office at 137 Broadway, New York. The system of transmission used by this company consists in the use of a wire laid on or under the surface of the earth in a conduit, and covered with an elastic insulating substance, provided with a slit or separable lips extending longitudinally its entire length, capable of opening to admit the passage of a moving brush or arm, and automatically closing immediately as the brush or arm passes, thus maintaining continuous contact with the conducting wire, which is also continuously insulated.

THE TELEGRAPH.

C. J. Barclay, has been appointed night manager of the Western Union telegraph office in Chicago, to succeed George Thomson who has resigned to take charge of the affairs of the Western Union company at Los Angeles, Cal. Mr. Barclay is a young, energetic and thoroughly competent man.

Nearly two hundred telegraphers, of both sexes, employed by the Baltimore & Ohio Telegraph company in the operating room at Broadway and Canal street, New York, were notified by Manager J. W. McLaren, on the 18th, that their services would not be required after the last day of this month; that the Western Union company was going to close the office.

Edgar Louis Richter, formerly a telegraph operator in Chicago, a short time ago removed to the Odanah Indian reservation to act as operator for the Milwaukee, Lake Shore & Western railway. He met an intelligent, well-educated and handsome half breed Indian girl, by name Marie Gentry, fell in love, proposed, was accepted and married in one month.

The El Paso & Northeastern Railway & Telegraph company has just been chartered under the laws of Texas with a capital stock of $3,000,000. The incorporators are Ex-Senator Wm. Windom, of Minnesota, Ex-Senator Stephen W. Dorsey and John Riley of New Mexico, and N. L. Detwiler, Sam Schultz, John F. Dowling. W. J. Fewell, E. A. Warner, F. H. Clarke and F. N. Detwiler, of El Paso. The road will run from El Paso northward to the White Oak coal fields in New Mexico, thence to Las Vegas, thence through the panhandle of Texas to connect with the Rock Island road now building through that country.

A Philadelphia press dispatch of the 15th says: "The committee on law of the city council held a meeting this afternoon, at which a report was submitted from the sub-committee to which had been referred the matter of the bond of the Baltimore & Ohio Telegraph company, recommending the council to instruct the city solicitor to proceed against the corporation for the recovery of $50,000, the amount of the bond, which was agreed to. The Baltimore & Ohio Telegraph company executed a bond with the city on obtaining the privilege of stringing wires, etc., which it was provided should be forfeited to the city in case of merging with any other corporation.

The Pacific Mutual & Mutual Union Telegraph companies have advanced their rates on all east bound business from Kansas City. The increase amounts to 20 per cent. on messages to St. Louis and Chicago, and about 25 per cent. on messages for points east of Chicago. The prices now are the same on east bound business that they had always been on west bound business. Previously the New York merchant had paid 50 cents for a ten word message to Kansas City, while the Kansas City man paid only 35 cents for a similar message to New York An increase in the rate on east bound messages by the Western Union Telegraph company has also been made. What was known as the Mutual Union rate has been abolished, together with all special and rebate rates, leaving the tolls uniform, the same as before the original Mutual Union deal. The change added 40 per cent to night rates and 20 per cent to day rates.

THE TELEPHONE.

Underground wires in New Orleans would well-nigh have to be submarine wires, for the water level is but three feet below the surface.

A press dispatch from Waukesha, Wis., dated the 18th, says: "E. S. Marsh, manager of the telephone exchange here, has mysteriously disappeared. No clue can be obtained to his whereabouts. He is short some $200. He had always stood well with the company."

Herr Muller, the manufacturer, had returned from his honeymoon trip, and after a week of connubial bliss in the new home he awoke to the necessity of attending to his business, and so with heavy heart he said good-by to his little wife and proceeded to his office, situated about a mile from the house. The long hours of separation from the partner of his joys and sorrows were, however, a severe trial to his fortitude, and he hit upon the expedient of connecting the house and his place of business by means of a telephone wire. And now sweet words of tenderest affection were exchanged between the loving couple every hour of the day. A week later the work of the office became more absorbing, and our manufacturer felt himself obliged to put a stop to this waste of time; besides he began to find that Ludmilla's cajoleries were growing somewhat tedious and commonplace. But he would not have his wife suspect this for worlds. His inventive genius found a way out of the difficulty. There was an old servant of the firm, Herr Kobes by name, almost past work, but re-

tained to do odd jobs about the place. He was a queer old bachelor, with a red nose and a romantic turn of mind; for he was an adept at whispering soft nothings in the ears of young ladies, and fondly imagined the whole of the fair sex were in love with him. Besides, the tone of his voice had a striking resemblance to that of his principal. Herr Muller gave this man certain private instructions, and next morning Herr Kobes was duly installed at the telephone and engaged in an amorous conversation with his invisible partner, while his principal was busy with his correspondence. Quite contrary to Muller's expectation, Ludmilla appeared to take increasing delight in her husband's conversation, and the apparatus was kept constantly going. The manufacturer could now attend to his affairs without interruption, while at the same time his wife had no reason to complain of his coolness. This state of things was highly satisfactory. One day, having a business call to make in the neighborhood of his dwelling-house. he left the office earlier than usual, quite oblivious of old Kobes and the telephone, and after he had gone his errand he went straight home, as it was hardly worth while returning at that late hour. But what was his astonishment on entering the room, to see his wife sitting on the sofa deeply absorbed in the latest novel, and at the telephone busy talking with the gentleman at the office—Babette, the old cook!—*Fliegende Blaetter.*

NEW ENTERPRISES.

At Rockwell, Ill., W. L. Howard is building a $2,000 residence, in which he will put electric bells.

N. McElroy of Kansas City, Mo., is building a residence to cost $3,600. Electric bells will be put in.

Workman & Dunning of Evart, Mich, are building a new foundry and machine shop. They will put in new machinery and do all classes of work in their line.

E. Park of the same city is building a three story residence at a cost of $12,000. It will be fitted with electric bells.

W. A. Kelly of the same place, is building a three story residence, to cost $16,000, in which electric bells will be placed.

At Kansas City, Mo., M. L. Stansbury is building a residence of two stories to cost $3,500. Electric bells will be put in.

James L. Lombard, a banker of the same city, is building a three story residence to cost $30,000. Electric bells will be put in.

An insane asylum is to be built at Yankton, D. T., at a cost of $70,000, from plans made by C. P. Brown, architect, Sioux City, Ia.

Albert Marty of Kansas City, Mo., is erecting a business building of three stories to cost $50,000. The building will be provided with the electric light and fire alarms. The same gentleman is building an addition to a block which will cost $20,000. It will be fitted with electric bells.

Personal Paragraphs.

C. D. Crandall, secretary of the Missouri & Kansas Bell Telephone company, of Kansas City, Mo., was in Chicago last Monday.

Willard L. Candee, treasurer, and J. Wetmore, representative of the Okonite company of New York, were guests at the meeting of the Chicago Electric club last Wednesday evening.

Joseph Drexelius, chief train dispatcher of the western division of the New York Central road, stationed at Rochester, N. Y., was recently united in marriage to Miss Emma M. Brayer of the same city. Mr. Drexelius is a young man of sterling worth, popular both with the officers of the company he has served many years with great fidelity and the small army of operators he has had under charge. Congratulations and good wishes were as numerous as hearty on the happy occasion.

Marvin Hughitt, the executive head of the Chicago & Northwestern railroad and one of the best known railroad men in the west, was a poorly paid telegraph operator not many years ago.

Miscellaneous Notes.

Uriah A. Boyden of Boston, Mass., has deposited with the Franklin Institute, Philadelphia, $1,000 to be awarded as a premium to any resident of North America who shall determine by experiment whether all rays of light and other physical rays are or are not transmitted with the same velocity. Competition will close the first day of January, 1888.

Gates A. Clark, an engineer in the employ of the Edison Electric Illuminating company, at Rochester, N. Y., has devised and patented a smoke-burning apparatus which consists of a cylinder extending the entire length of the boiler on each side, beneath it and just over the fire. Each cylinder is provided with a large damper throughout its length. The coal is thrown into these cylinders instead of upon the fire and is allowed to remain there until it is coked. The smoke and gases pass out through the damper, around under the fire grate where they are mixed with a sufficient quantity of air to make them combustible. They are burned as they pass through the bed of live coal, and no smoke issues from the chimney. At the same time the combustion of these gases furnishes a large amount of heat which would otherwise be lost. The coke in the cylinder is then dumped by an ingenious contrivance, upon the fire under the boiler and burns without smoke.

The house of E. S. Washburn, in Chicago, was burglarized last week, entrance being gained through a scuttle in the roof. The house had been provided with the most approved burglar alarm, but the seemingly unimportant scuttle in the roof had been neglected.

New York police calculate that if burglar alarms were not in such general use in that city, it would be necessary to employ fully twice as many patrolmen to prevent burglaries. They declare that these automatic alarms are of the greatest use in preventing crime or making it ineffective. Inspector Byrnes takes the greatest interest in these inventions, and a few days ago he spent considerable time in examining and testing a little arrangement by means of which a cartridge was exploded when any person tried to open the window to which it was affixed. The contrivance was an exceedingly simple and inexpensive one, but it was a burglar alarm, and the inspector was deeply interested.

A Duluth newspaper, with an imagination of great intensity, telling of the power of the magnetic iron ore of that vicinity, says that the miners have to wear moccasins, because the ore draws all the tacks from their boots; that houses near the mines have to be built with wooden pins or bolts, because the iron draws the nails; that a wild duck that had inadvertently swallowed a few hairpins, was stopped in its flight over the mines, drawn earthward, and made a prisoner, and that persons with too much iron in their blood are so magnetized that they sleep in a trance.

The *Bulletine Internationale de l'Electricité* is authority for the statement that the trials of the Tamine accumulator which have been carried on for some months by the Société Industrielle d'Electricité, at Brussels, have not resulted satisfactorily, and their manufacture has been suspended.

Over a hundred guests of a hotel on Dearborn street, Chicago, were awakened at two o'clock, on the morning of the 17th, by the ringing of the electric fire alarm bells in their rooms. The hotel was badly damaged but no lives were lost through the timely warning given.

In Philadelphia, November 17th, there was a gasoline explosion in a building used by the Edison Electric Light company as a storehouse for tools and supplies used in the construction of conduits in the streets. Seventeen laborers of the night gang were seated together while two of their number were filling a lamp with gasoline. It is said that one of the men was under the influence of liquor, but at any rate, the gasoline was poured on the flame of the lamp instead of in the body, and a terrific explosion followed. Thirteen of the laborers were frightfully burned and had to be taken to the hospital.

To the accidental ignition of a parlor match, lying on the floor of the cotton shed of Brooks, Neely & Co., at Memphis, Tenn., is ascribed the origin of a $250,000 fire.

Business Mention.

At the fire in the Saratoga hotel, Chicago, recently the alarm was given from the office to the guests in their rooms by the fire alarm and guest call put in by the Western Electric company, "and many lives were saved thereby" the architect of the building says.

The Fort Wayne Jenney Electric Light company will put 360, lights of 2000 candle power in Utica, N. Y., and 300 in Harlem, N. Y. W. J. Buckley, manager of the Chicago office of the same company, has sold Swift & Co., 1,200 lights, 600 for their packing house in Kansas City and 600 for their packing house in Omaha. The sale also includes 20 arc lights.

Electrical Patents.

Issued. Nov. 15, 1887.

373,043. Signal for Telephone Instruments. John M. Baker, Paola, Kan.

Designed to give additional alarm where the ordinary call bell could not be heard. It is, essentially, a trap which is sprung by a weight which is caused to fall when the clapper of the bell vibrates.

373,044. Electric Belt. George S. Bennett, Denver, Col.

373,046. Electrical Railway. Benson Bidwell, Philadelphia, Pa.

373,061. Electric Temperature Regulator, Lucien F. Easton LaCrosse, Wis.

373,064. Galvanic Battery. Carl Gassner, jr., Mentz, Germany,

The invention consists in the combination of zinc oxide with the exciting agent, the oxide being in a state of mechanical mixture throughout the exciting agent.

373,073. Alarm. William G. Jeorke, New York, N. Y.

373,088. Therapeutic Battery. Miles A Morehouse, Johnsburg, N. Y.

373,102. Electric Bell. George M. Sternberg, U. S Army.

373,103. Electric Valve Controller. George M. Sternberg, U. S. Army.

The temperature regulator is constructed so as to admit of the automatic control of the admission valve from any one of its two limit positions, or from one intermediate position.

373,104. Electric Valve Controller. George M. Sternberg, U. S. Army.

373,108. Electric Motor. Elihu Thomson, Lynn, Mass.

The invention consists in applying to the field-magnet of the motor any suitable means or devices that shall have the effect of counteracting or cutting down the strength of the magnetic field, and controlling the action of such device through any of the effects consequent upon or manifested through an increase in the speed of rotation of the armature upon a diminution in the load.

373,138. Clock Synchronizing Apparatus. Charles J. Hexamer, Philadelphia, Pa.

373,145. Dynamo Electric Machine and Electromotor. William Main, Brooklyn, N. Y.

The invention is covered by twenty-one claims. Efficiency, with the least weight and greatest compactness are the leading features.

373,146. Electromotor and Dynamo Electric Machine. William Main, Brooklyn, N.Y.

The invention aims: "First, to enable the field magnet to be made as short as possible; second, to enable the field-magnet to be given the utmost desirable area of cross-section; third, to simplify the field magnet coil and to bring the greatest possible number of turns thereof into closest possible proximity to the field magnet; fourthly, to so arrange the field of force relatively to the armature that the path of least resistance for the lines of force shall be through the armature coils, thereby avoiding the wasting of the lines of force by their escape around the armature, and, fifthly, to enable all moving wire to be dispensed with."

373,152. Telegraph Key. Alonzo Oakes, Taylor, Wis.

373,160. Electric Train-Signal Apparatus. Joseph C. Tiffany and John R. DeMier, Las Cruces, N. Mex.

373,207. Mail Box Indicator. Jacob P. Tirrell, Somerville, Mass.

373,211. Magnetic Separator. Joseph Wenstrom, Orebro, Sweden.

373,289. Sectional Draw-Rod for Placing Electric Wires in Underground Conduits. William H. Hart, Brooklyn N. Y.

373,334. Battery Jar. Charles A. Brown, Portland, Me.

The battery jar consists of wood or paper pulp impregnated with coal tar.

373,369. Automatic Regulator for Dynamo-Electric Machines Charles D. Jenney, Indianapolis, Ind.

373,383 Railway Telegraphy. Granville T. Woods, Cincinnati. Ohio.

373,394. Electric Cable. Amos E. Dolbear, Somerville, Mass.

The cable is made up of a flexible armored sheath and a conductor, between whose outer surface and the inner surface of the sheath is a space.

373,399. Electrode for Forming Clots in Varicose Veins, Jonathan R. Hamilton, Minneapolis, Minn.

373,407. Interlocking Coupling for Lightning Rods, George R. Kress, Pittsburg, Pa.

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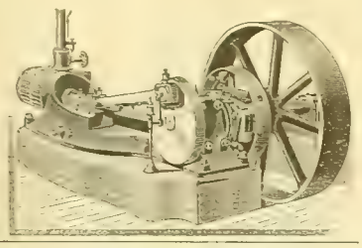

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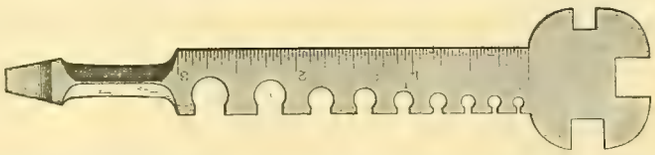

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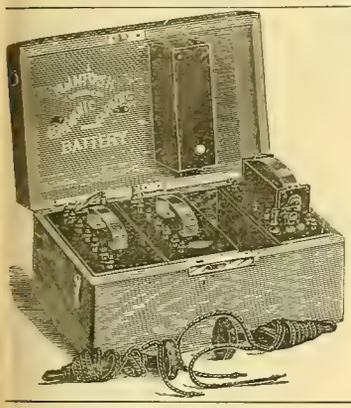

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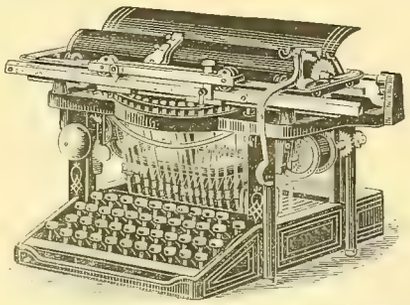

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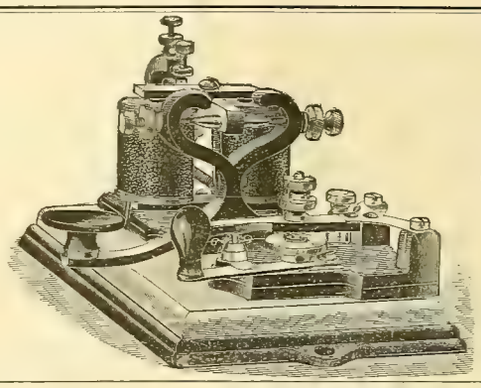

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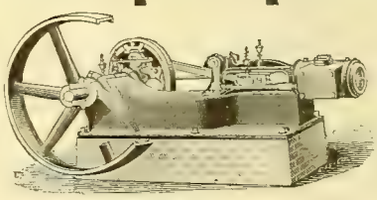

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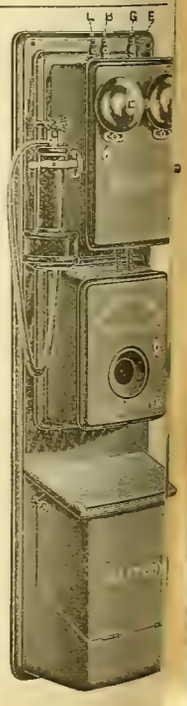

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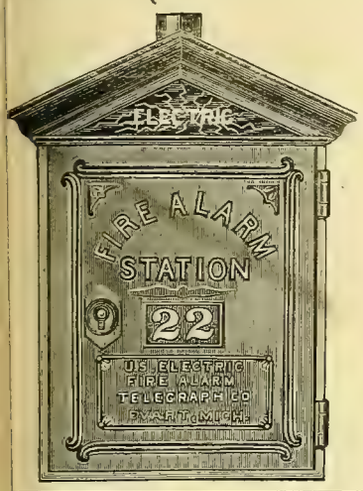

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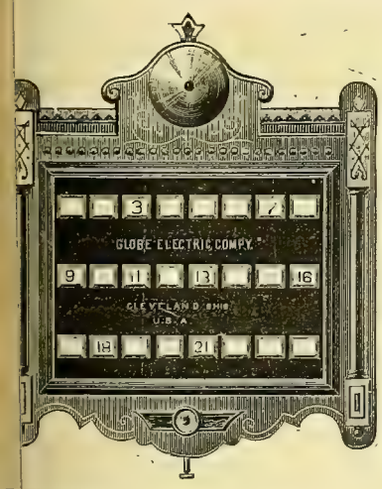

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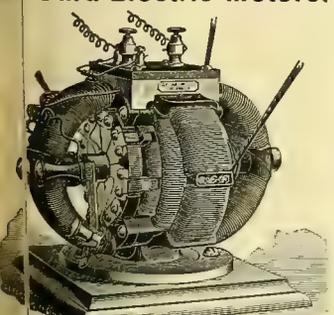

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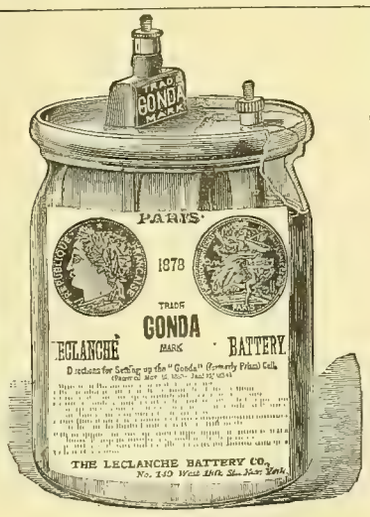

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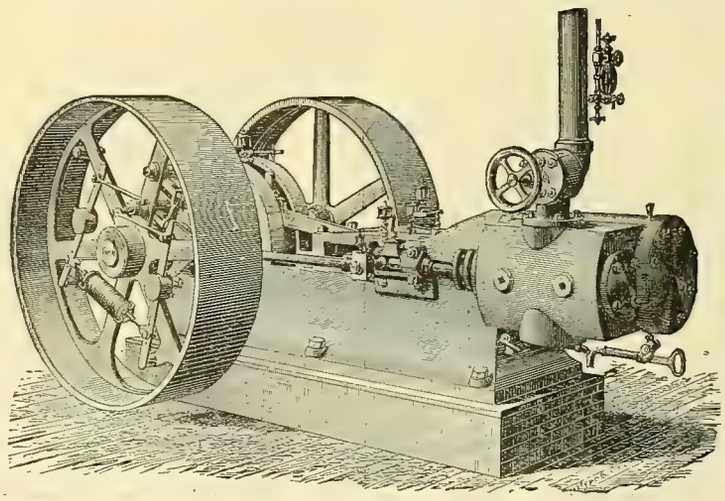

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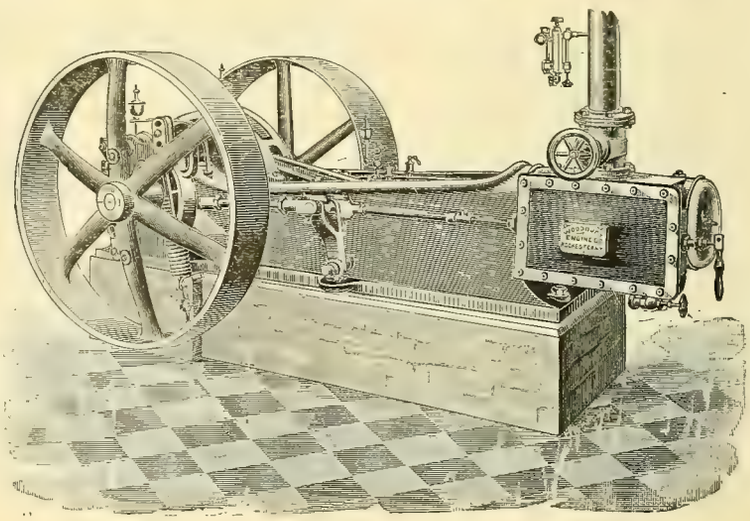

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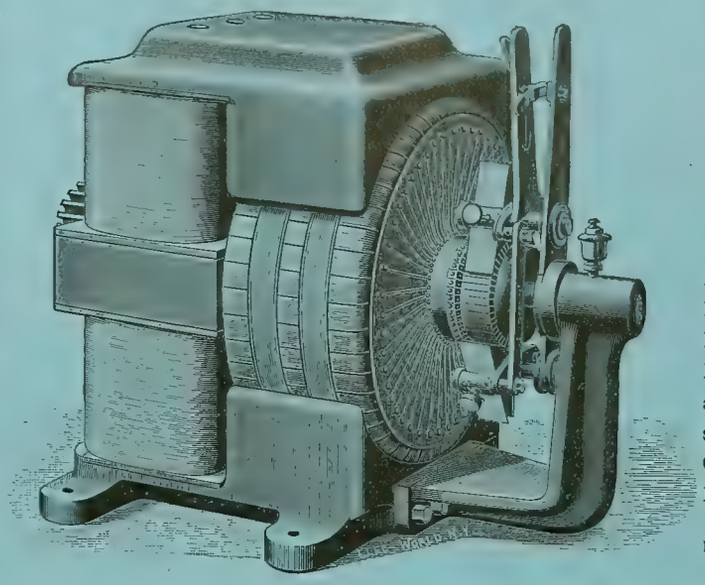

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OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

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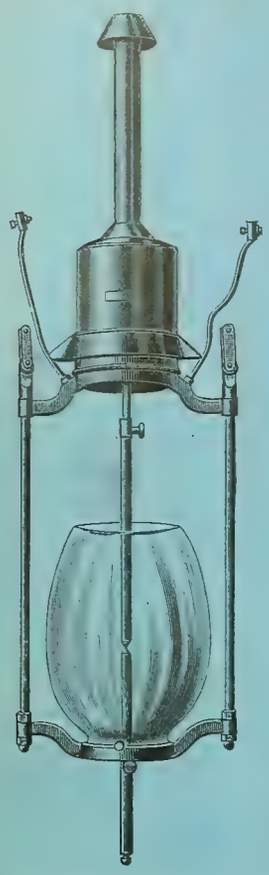

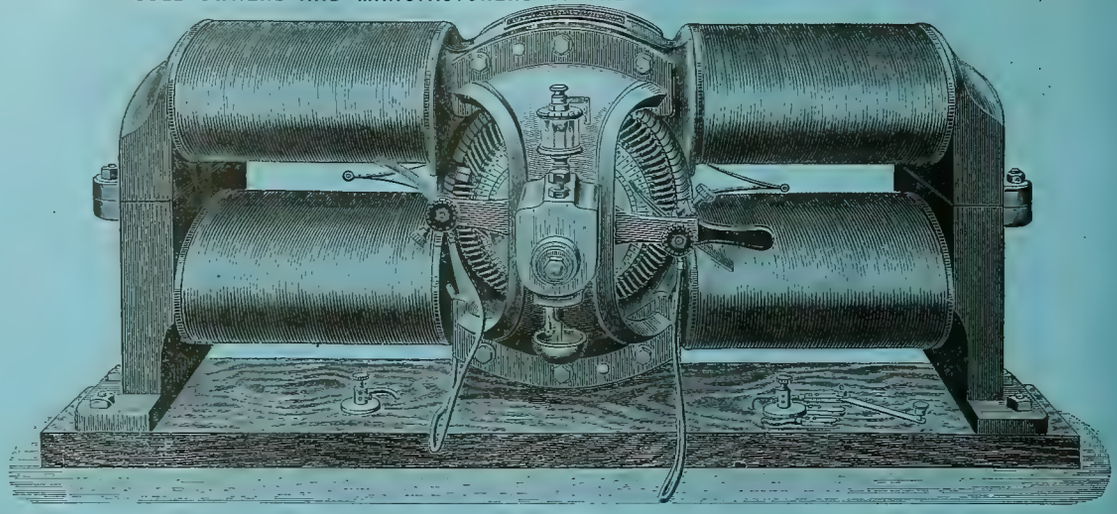

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The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

ONLY GOLD MEDAL

At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

This system HAS NO EQUAL for SIMPLICITY, DURABILITY and STRENGTH OF LIGHT.

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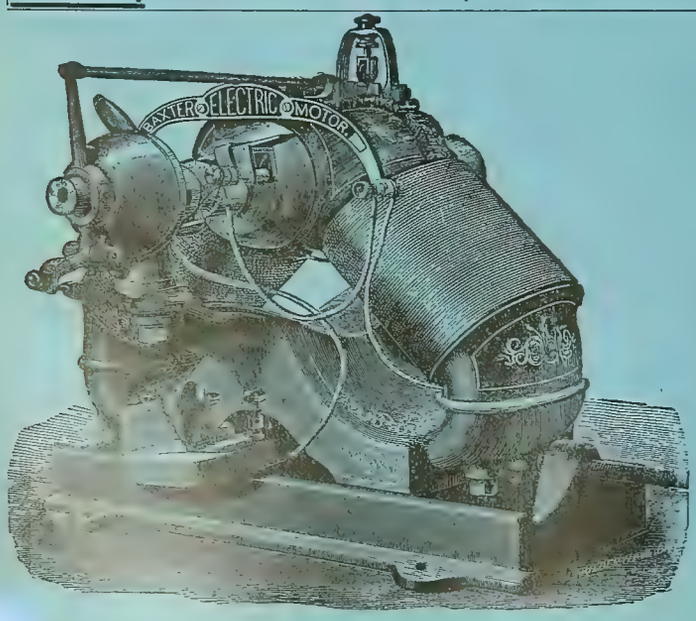

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Western Electrician.

EVERY SATURDAY.

Vol. I. CHICAGO, DECEMBER 3, 1887. No. 23.

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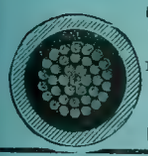

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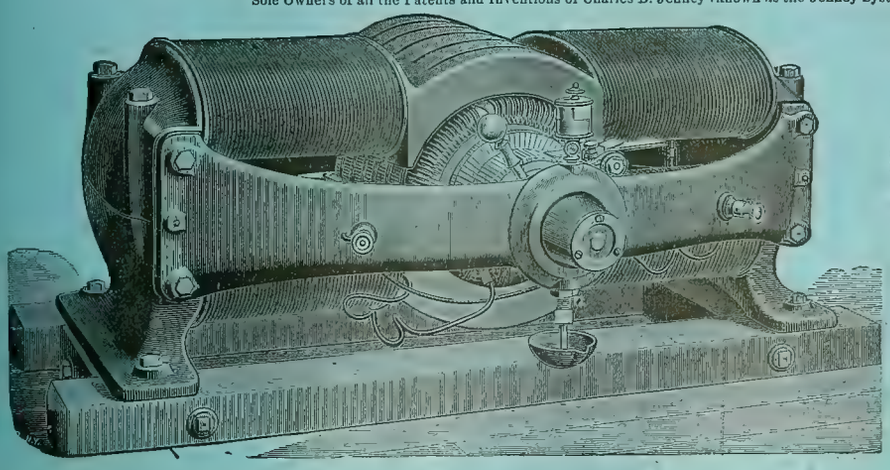
Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



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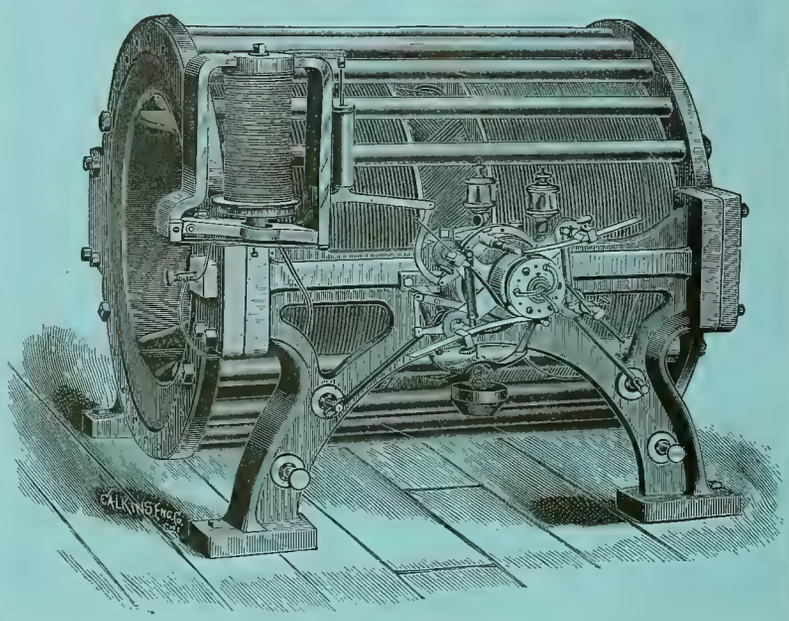

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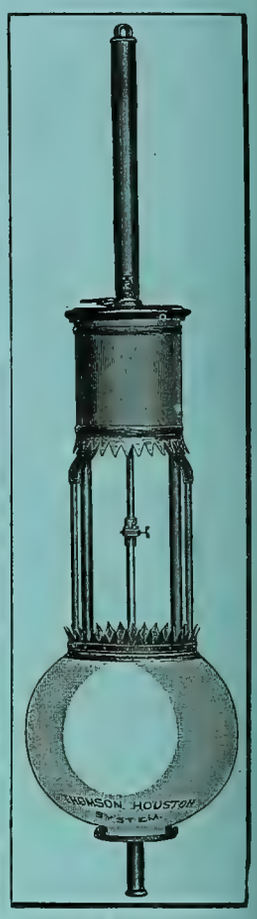

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FOR DIRECT LOW TENSION

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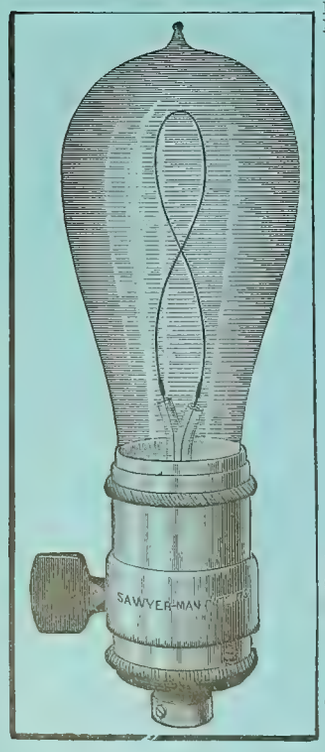
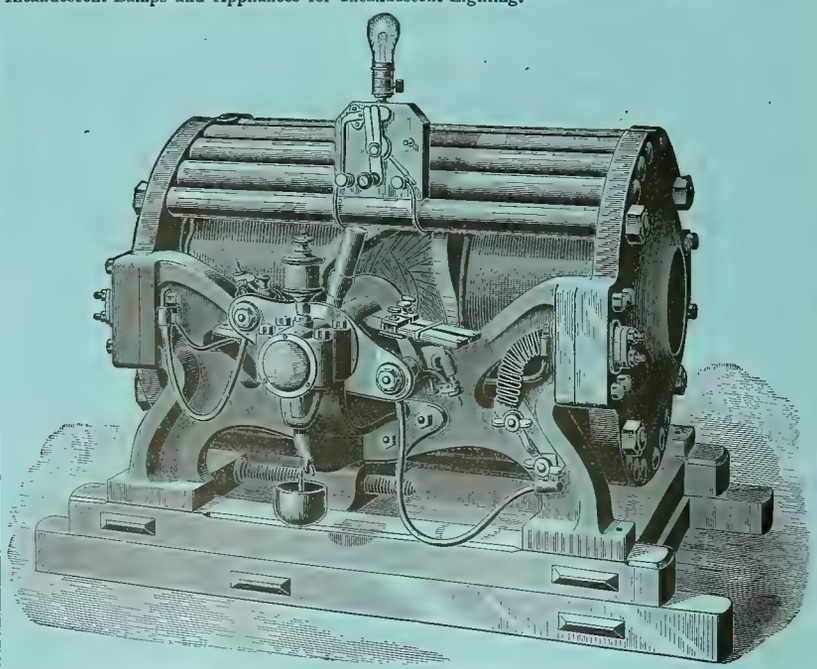
These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

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Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

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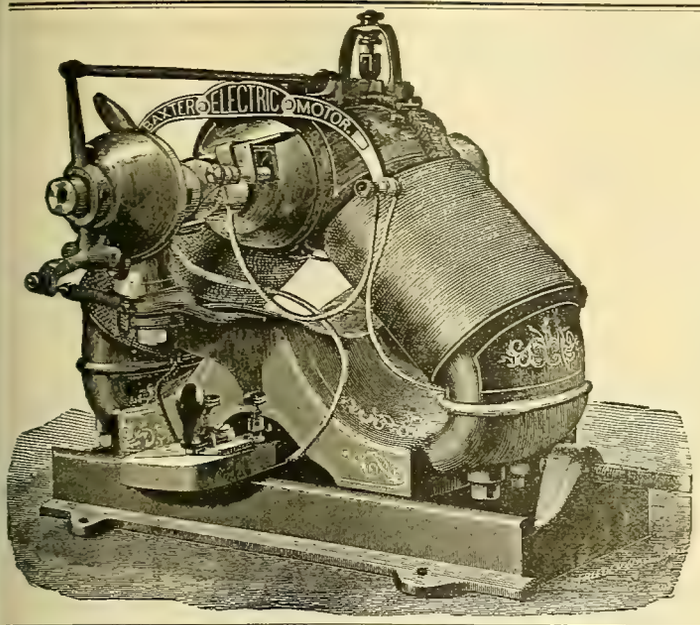

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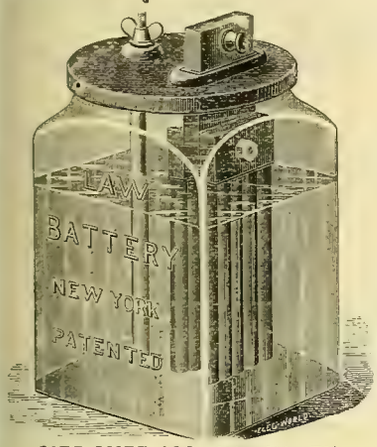

SIZE OVER ALL, 4¼ x 4¼ x 7½.

THE NEATEST OF ALL BATTERIES. THE BEST AND CHEAPEST.

With the exception of glass broken by carelessness, and the zinc and sal-ammoniac consumed in the production of current, **all parts of this Battery are Guaranteed** to be **Everlasting.** Perfectly **uniform** and **reliable** in action, of **faultless construction** and **beautiful appearance.**

PERPETUAL NEGATIVE ELEMENTS!!!

These consisting of specially prepared prisms of Carbon are fine depolarizers, performing this function indefinitely, **do not require renewal,** as is the case where chemical depolarizers are employed, thus a **great economy** is effected. These cells are so constructed as to prevent evaporation of the solution, and crawling out of the salts. Thousands of these cells now employed for **Telephone Transmitters, Gas Lighting, Annunciators, Burglar Alarms** and other **Automatic Devices** are giving **Perfect Satisfaction.**

The many Physicians now using the "**Improved Law**" as an office battery, are unanimous in their expressions as to its perfection and adaptability for electrolysis and general galvanization, requiring no renewal nor attention in from two to five years, the latter depending only on the amount of use.

Note:—This battery is not suitable for Galvano Cautery nor Incandescent Light purposes.

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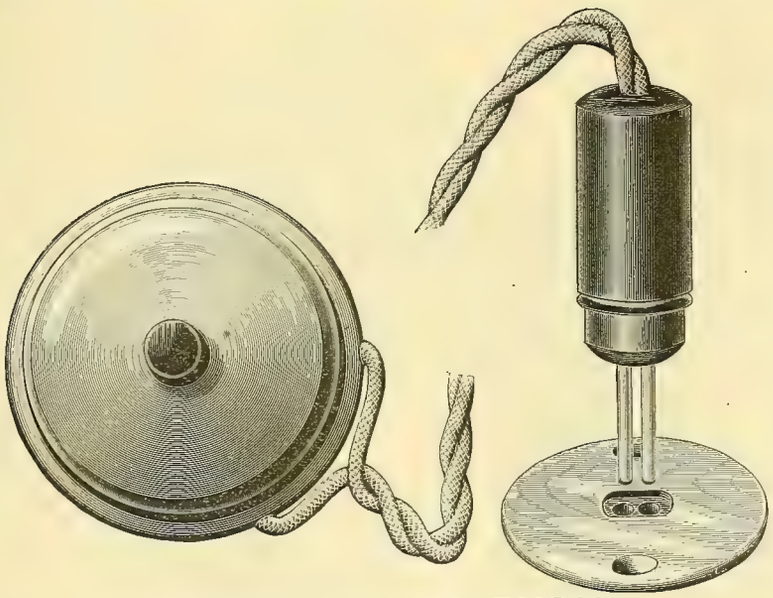
Finest Assortment and Low Prices.



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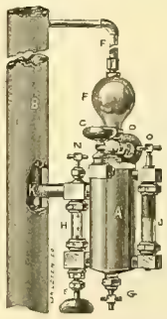
There will be a meeting of the CHICAGO ELECTRIC CLUB, Monday evening, December 5th, at 8 o'clock, at the rooms of the Club, 122-124 Clark Street.



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Are pronounced the best by more than 20,000 users. They are especially adapted to

HIGH SPEED ENGINES FOR ELECTRIC LIGHTING

Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

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CALL BELLS, "POST'S" MAGNETO BELLS, PINS AND BRACKETS, BATTERIES, ETC. ETC.

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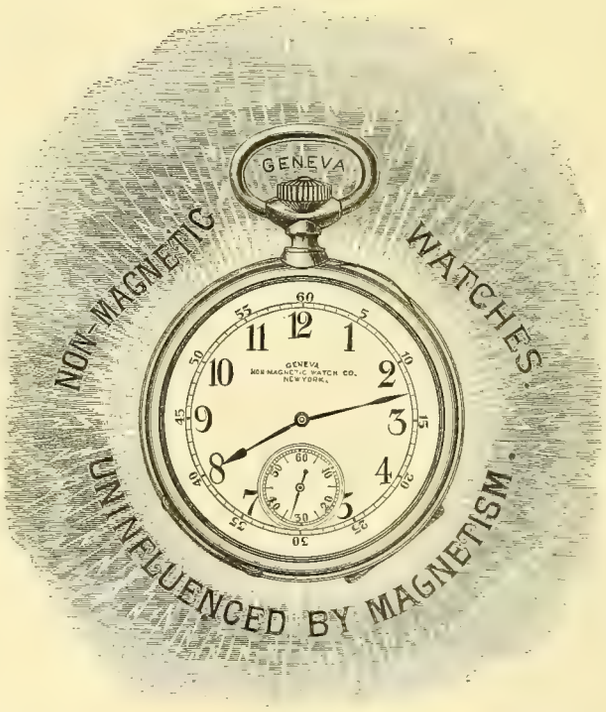
Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode.

Ask your Jeweler for them.



Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the works, they require no shield or other protection.

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Complete Steam Plants for Electric Light and Power.

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Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

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Single Valve and Corliss Valve

ENGINES.

SELF CONTAINED AND SINGLE CRANK

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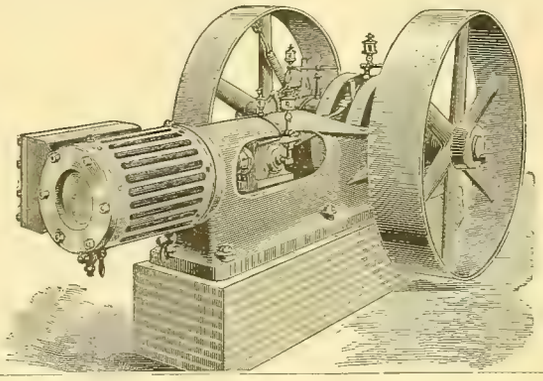
Specially Adapted for Electric Lighting.



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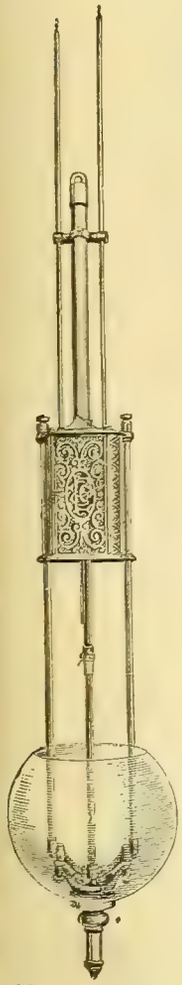
9 Dey Street, New York. Factory, 204 to 216 Willoughby Street, Brooklyn, N. Y.



Excelsior Electric Light

TO THE FRONT

By reason of its new Automatic Regulator that does not depend on merely shifting the brushes, but cuts out a portion of the field magnets as each light is turned off, saving the power in proportion to number of lights burning down to one light.

Dynamo is the simplest of all makes and requires no attention except to keep it clean. The lamps are ornamental, can be used in connection with any system from seven to fifteen amperes without change of magnets.

The first and only system where Incandescent lights are successfully running off Arc Light Circuits.

Twenty five dollars will repair our dynamo in places that cost seven hundred dollars on other systems.

Our system is original, and not copied after foreign obsolete patterns.

Our prices are reasonable.

The only system that has local companies paying 40 per cent. and above on its capital stock.

We take the contract wherever we bid.

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EXCELSIOR ELECTRIC CO.,

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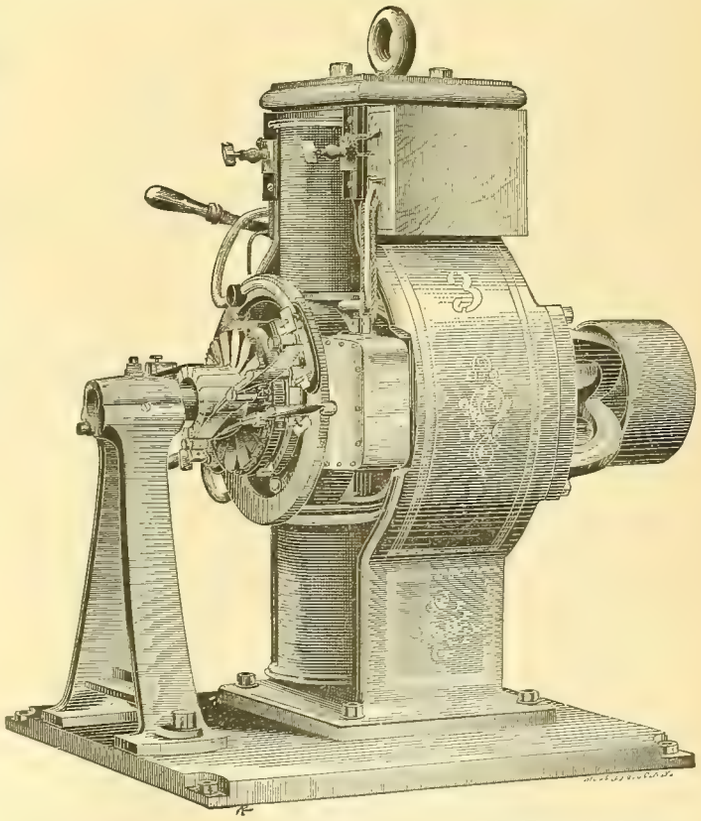

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We have a considerable quantity of **KERITE WIRE** size No. 13 B. & S. Gauge, 6-32″ insulation, which has been in use, but is practically as good as new.

We will send a sample of this wire and quote a very low price to any one who inquires.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

THE EDDY ELECTRIC MANUFACTURING CO.

MANUFACTURERS OF **Automatic Electric Motors** (MATHER PATENTS.)

In all sizes from ½ H. P. upwards. The efficiency of these Motors is over 92 per cent. They require no rheostat, are perfect in regulation, simple in construction, and thoroughly and substantially built. Also manufacturers of

THE MATHER DYNAMO ELECTRIC MACHINE,

FOR ELECTRO-PLATING, ELECTROTYPING, COPPER REFINING, ETC.

These Machines cannot reverse, use no water, do not spark, and are noiseless. Satisfaction Guaranteed.

THE EDDY ELECTRIC MANUFACTURING CO., HARTFORD, CONN.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, MANAGER WESTERN DEPARTMENT, 216 LA SALLE ST., CHICAGO.

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly,

C. C. Warren
MANAGER WESTERN DEPARTMENT.
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously insyalled by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 300 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C C Warren Esq
Dear Sir. I have written the answers opposite your questions above as for your regulation, and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me.
Yours truly J. F. Conklin.

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, DECEMBER 3, 1887. No. 23

An Electric Stove.

Professor J. P. Barrett, city electrician of Chicago, and Jacob F. Mehren, connected with the fire alarm telegraph of the same city, have devised a unique and novel method of heating by electricity. The accompanying illustration of a modern gas stove, which they have diverted from its original purpose to that covered by their design, will serve to give a clearer idea of their system. The modern gas stove is so familiar that it is hardly necessary to describe it further than to state that essentially it is a sheet iron box having an opening in the lower part of the front and a concave burnished reflector, which is so placed in the lower part of the box as to reflect the light and heat from the gas burners within the stove in a horizontal direction out into the room. Within a stove of this description the inventors have placed twelve incandescent lights of 16 candle power, the sockets of which set into a base plate faced on the lamp side with a polished metal plate, and on the reverse side with a vulcanized fiber. This plate can make a half revolution on its axis which projects through the sides of the stove at points very near the location of the handles, one of which is seen in the illustration. The bearings of the axis are insulated from the sides of the stove, and connections are made through the bearings, thence to brass strips on the back of the vulcanized fiber plate, and then through the lamps. The object of half revolving the plate with the lamps is to throw the heat directly to the top of the stove or down upon the reflector and thence out into a room.

The amount of heat developed in this stove is remarkable. Two quarts of cold water placed in a cup within the ornament seen on top of the stove illustrated, came to the boiling point in 20 minutes, while a reversal of the lamps so as to direct the heat developed by the lamps on the reflector and thence into the room, had an immediate effect upon the surrounding atmosphere.

It is thought that the new stove will find a field of usefulness, particularly in offices where the incandescent circuit is available. When the light is directed downward on the reflector, the stove is exceedingly brilliant and cheerful, while the heat, as might be inferred from the statement that water is boiled on the stove, is sufficient to thoroughly warm a room of moderate dimensions.

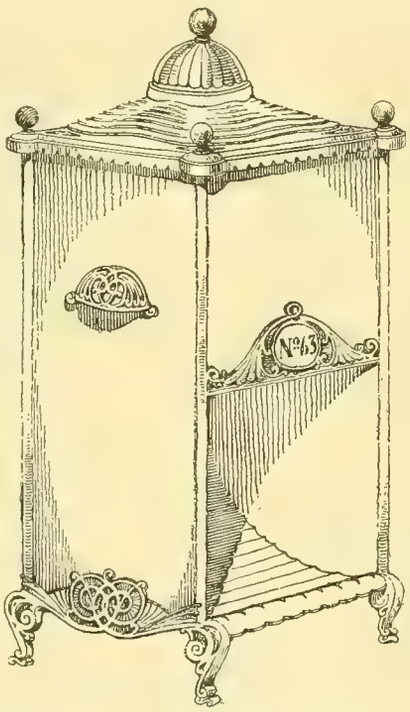
Comparisons of the economy of the stove for heating as compared with gas have not been made, but in other respects, such as brilliancy, safety, and ease of manipulation, the palm must be awarded to the electric stove.

A New Form of Earth Plate.

In *Electrotechnische Zeitschrift* for October, Professor Dorn proposes a new form of earth plate. It consists of a flat open box, made of wood or cement, and coated inside with asphalt. This is placed at the bottom of a hole in the ground. An amalgated zinc plate lies flat in the box, and an insulated wire leads from it to the surface. Care must, of course, be taken that the joint is well covered, so that nothing but zinc is in contact with soil. An earthenware pipe stands on the zinc and rises to the surface. The box is then tightly rammed with clay, soaked with concentrated zinc sulphate solution, and the hole filled up. Solid sulphate is dropped down the tube and solution poured after it. A little fresh sulphate from time to time will keep the plate in order.

Edison's New Phonograph.

So far as the mechanism of the new phonograph may be described at present, it consists of a cylinder which revolves upon itself and also has a side movement governed by a very fine thread, so that a fixed pencil would trace upon the cylinder a spiral with the lines almost touching. The motive power used is an electric motor devised by Edison himself, a very poor motor economically considered, but one which does its present work of turning the cylinder at an almost nominal cost and without noise, which is the great thing to be sought. The motor runs with four cells of a simple battery, which can be renewed at the end of each month for less than a dollar; with this power the phonograph will work for four or five hours every day during the month. Upon the cylinder is placed a sheet of soft substance somewhat resembling the wax used at times with the old phonograph. The chief feature of the new instruments made by



Edison in the last six months consists in a radical change in the apparatus by which the vibrations of a diaphragm under the sound of the voice are marked upon the cylinder and also in the reproducing apparatus, the two being entirely distinct, while in the old phonograph the same device was used for both purposes—to make the sound indentations and to reflect them when the phonogram was repassed through the machine.

The phonograms will be sold in the shape of small cylinders one and a quarter inches in diameter and from one inch to four inches in length. The one-inch phonograms will contain two hundred words or what is considered quite sufficient for an ordinary business letter; they will cost 15 cents a dozen. The full size phonograms of four inches in length will contain eight hundred to one thousand words, according to the rate of speed of the speaker, and will cost about 36 cents a dozen. Of course, there is no manipulation of the apparatus necessary. It will occupy about the room necessary for a typewriter, the cells going in any closet or under the table. The motor will be boxed over, and nothing but the revolving cylinder and the mouthpiece will be in view. One touch of a little switch sets the machine in motion. Then the mouthpiece is adjusted to the cylinder and the talking may commence; the same process is gone through when the machine is to read. It will be seen that the cost of the phonograms is a great deal more than that of letter paper, but provision is made for the use of the same phonogram over again twelve times if the messages which it contains are not worth keeping. A little knife is attached to the machine which takes a shaving off the surface of the phonogram seven-thousandths of an inch thick and gives a fresh surface; this process may be repeated twelve times. The boxes for mailing the phonograms will be ready at the same time with the instruments and resemble the old-fashioned wood-turned pill-boxes. Mr. Edison hopes to get the government to carry them at the same rate as letters.

The phonograms for the reproduction of books or long pieces of music will be entirely different from the commercial sizes, and will measure four inches in diameter by ten inches in length. Each phonogram of this size will contain about ten thousand words, or perhaps more, and, from tests made with "Nicholas Nickleby," that book will go into eight cylinders of this size.

The duplication or multiplication of phonograms of books or music is now the problem with which Edison is steadily working.

The speed at which business letters can be dictated in a satisfactory manner to the phonograph has been a matter of considerable test. One of Edison's assistants has read from a book at the rate of 245 words a minute, or faster than most fast speakers, without making an unintelligible mess of the result. The speed at which a message is given the phonograph, of course, regulates the number of words which can be put upon one phonogram.

Western Union Business.

President Norvin Green, of the Western Union Telegraph company is thus quoted in a press dispatch:

"The telegraph is the best barometer to indicate the commercial condition of the country that can be found. It varies directly in volume of business as trade varies, except in time of of panic, when the telegraph business increases though only to fall afterward. The charge that this company has increased its rates since the absorption of the Baltimore & Ohio line is not true. The rates to Chicago and St. Louis, which were fifty cents, are now forty cents. To St. Paul, Minneapolis, Omaha and that range the rate, which was 60, is now 50. There is scarcely a Western Union rate any where that has been increased, except the ten-cent and fifteen-cent rates. These the other companies were handling at a loss. The Postal and United Lines have come up to our increase and are going to stand by it. I demonstrated, in fact, in my last annual report that the average cost to us of handling a message was a little over 23 cents On city business, for instance, from one station to another, we make nothing at all, as each message has to be relayed and requires four operators, and if sent up town five cents additional for delivery.

"The sequel of the deal shows that we have taken all the Baltimore & Ohio business and at better rates. The Baltimore & Ohio business last year averaged $26,000 per week. Of this about three-

fifths, or $21,000 or $22,000 came from the larger or test offices, which report weekly. A comparison of our revenues from the test offices for the past three weeks in this month shows $218,464 against $173,590 for the first week in November of last year; $219,300 against $169,900 for the second week, and $225,467 against $170,856 for the third week. We had an increase for the weeks just before varying from $12,000 to $17,000. Add to the $21,000 of the Baltimore & Ohio receipts our own average increase of $16,000 and you get $37,000. This leaves about $15,000 per week as the result of advancing the non-paying rates of the Baltimore & Ohio. The estimated general increase in our business is about $75,000 per week over last year."

Dr. Green further gave the figures from the leading offices of the country, first for the first three weeks of November, 1887, and secondly for the same weeks in November, 1886. They were as follows: New York, 1887, $32,600, $30,600 and $33,700; 1886, $24,100, $25,500, $25,400. Chicago, 1887, $18,700, $17,900, $20,900; 1886, $14,700, $14,600, $14,500. Baltimore, 1887, $3,700, $4,000, $4,300; 1886, $2,400, $2,600, $2,700. Boston, 1887, $8,900, $9,600 $9,700; 1886, $6,500, $6,700, $6,800. Cincinnati, 1887, $4,700, $5,100, $5,100; 1886, $3,400, $3,400, $3,800. St. Louis, 1887, $8,600, $8,900, $9,000; 1886, $6,000, $6,000, $6,400. Kansas City, 1887, $4,500, $4,700, $4,900; 1886, $2,800, $3,000, $3.100. Louisville, 1887, $2,900; $3,000; $3,000, 1886, $1,800, $1,800, $1,900. New Orleans, 1887, $5,000, $6,300 $5,800; 1886, $3,500, $3,600, $3,900.

"We shall be able to handle the Baltimore & Ohio business," he continued, "at a cost of 40 per cent. of its receipts as soon as we get rid of their rental. We have got off some and shall get rid of more on the first of May. We shall put in effect on December 1st an extensive scale of changes to equalize rates and make them consistent with each other in different parts of the country. This we could not do during a competing fight. We shall level all these downward however, and are leveling none upward except the ten-cent and fifteen-cent rates which could not be maintained at those figures except at a loss. Our average rate per message was reduced last year from thirty-one and one-fourth cents to thirty and one-fourth. This year it will be reduced below thirty cents, the reduction being made in the long rates."

The Electric Light in Germany.

According to Dr. Schilling, the number of electric light installations in the thirteen principal towns of Germany has increased during the last two years from 131 to 604; the number of arc lamps has increased from 591 to 3,280, and the number of incandescents from 10,403 to 50,469. The number of gas lamps in these thirteen towns is 1,221,882, and therefore, lamp for lamp, electricity furnishes about 4 per cent. of the total illumination. In Munich this proportion is as high as 8 per cent. According to another authority there are in Hamburg at the present time 78 installations of electric light; 325 arc lamps and 5,300 incandescents. About 1,000 horse power is employed for these installations, of which one-fifth is furnished by gas engines.

The Woolley Magnetic Engine.

The Woolley Magnetic Engine company, of Grand Rapids, Mich., are making the exceedingly simple motor shown in Fig. 1, in connection. The base, the pole pieces, and the supports for the armature bearings are cast in one piece. The bearings of the armature are phosphor-bronze. The commutator has two segments, and over the armature there is a cover, which serves the double purpose of protecting the armature from injury and preventing it in its rapid revolutions

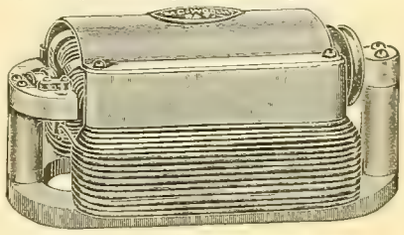


Fig. 1.

from doing injury to the fingers of the operator, for instance.

As might be inferred, this little motor has been devised for light powers, such as sewing machines, jewelers' lathes, or dental work, and a battery has been invented for the purpose of supplying current for the motor, when running on the class of work described. Figs. 2 and 3 show the battery; the former when put together, the latter when separated into its various parts, *A* showing the glass cell, *C* the carbon elements, *L* the porous cup, and *Z* the zinc element. The porous cup contains a small bowl of mercury in the bottom, in which the lower end of the zinc plates are immersed. This makes the zinc self-amalgamating and reduces local action to a minimum. It will be noted that the carbons present a large amount of surface—in a 7"x9" jar as much as 288 square inches. The carbons

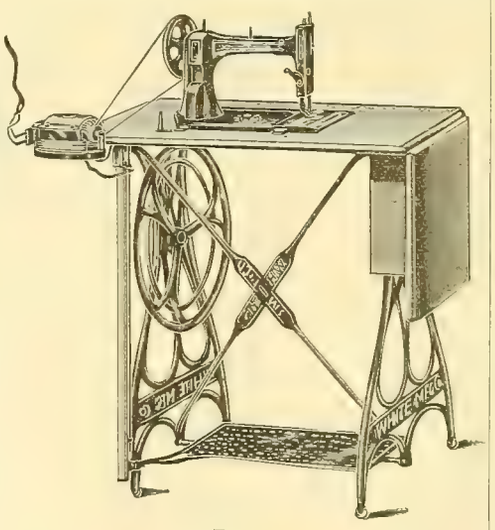


Fig. 4.

are the same as those used in electric arc lights, and are much harder and more durable than the ordinary carbon plates. The upper ends of the carbons are thoroughly saturated with paraffine, which fills their pores and prevents the salts and acid from gradually working upwards and destroying the connections, as is always the case with ordinary carbon batteries. The conducting ring which serves a double purpose of joining the carbons together, and also making a neat cover for the glass jar, is composed of pure lead, which is indestructible by the action of acids or the vapors arising from them.

Fig. 4 shows the application of the motor to a sewing machine and giving an idea of its size. The treadle of the machine is attached to a resistance coil of novel construction, as admirable for perfection of operation as the motor is for simplicity. Six rates of speed can be obtained by the use of this resistance coil.

Leonard & Izard, consulting engineers, of Chicago, recently made some tests of the motor, which are appended, prefaced by an explanatory note:

"The motor was run by current taken from the incandescent circuit, lamps being put in series with the motor to give the required current through the motor. The table gives the amount of electrical energy consumed expressed in volts and ampères, and also the speed and foot pounds of work delivered by the motor per minute, from which data are derived, the commercial efficiency being expressed in the last column. From this table the amount of work to be obtained from a battery of known e. m. f. and resistance may be readily ascertained. The current obtained by us when motor was doing maximum work was probably somewhat greater than would be obtained from a six cell bichromate battery, unless the battery had a very low internal resistance. The efficiency of the motor compares well with that obtained from other motors of same weight and similar type:"

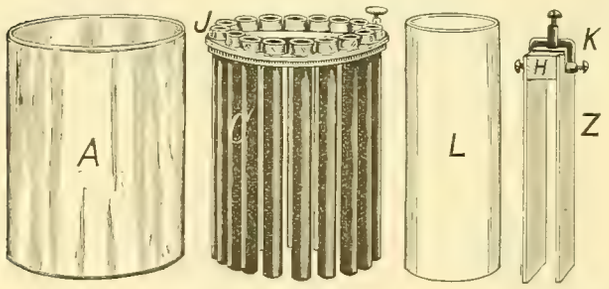


Fig. 3.

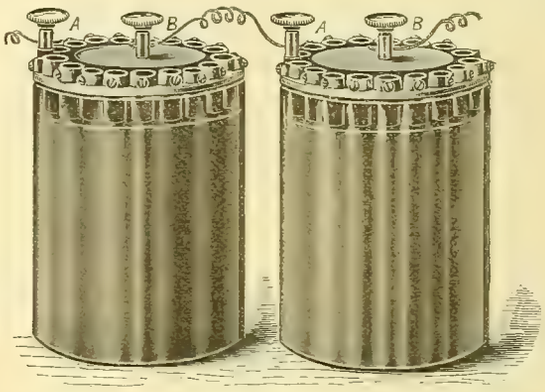


Fig. 2.

No of Test	Pressure Volts.	Current Ampères	Speed. R. P. M.	Ft. Lbs. pr Minute	Efficiency in per cent
1	10.06	3.07	2500	286	20.8
2	9.86	3.13	2350	2.6	21.5
3	13.24	3.08	3300	359	19.7
4	8.65	3.13	1530	215	20.3
5	12.46	3.38	2510	402	21.5
6	13.12	3.47	2860	393	19.3
7	9.50	3.56	1760	343	22.7
8	8.95	3.58	1580	326	22.7
9	11.90	4.06	1890	448	21.
10	11.45	4.24	1660	457	21.2
11	11.90	4.30	1710	549	23.3

Resistance of armature dead, - .71 ohms.
Resistance of fields dead, - - .22 ohms

Total resistance of motor dead, - .93 ohms.

Electro-Optical Phenomena.

M. Kundt, whose researches on electro-optical phenomena are familiar to the student of "advanced" physics, has recently examined the metallic layer which is frequently found in a Geissler tube from the material of the negative electrode, and he finds that it possesses the property of double refraction. Viewed by transmitted light these layers, which are of excessive tenuity, have the following colors: With gold electrodes, green, slightly bluish; with silver electrodes, blue, slightly violet; with copper electrodes, dirty green; with platinum electrodes, grayish blue; with iron electrodes, gray; with nickel electrodes, gray. The least trace of oxygen in the tube produces a deposit of the oxide, even with gold, silver or platinum, although the electrode itself remains unoxidized. By reflected light under oblique incidence Newton's rings are seen.—*Electrician.*

Telegraphing to Moving Trains.

By C. H. Rudd.

When Professor Morse brought out the magnetic telegraph, he achieved a success which seemed and still seems almost supernatural. The exhibition of the expansive power of steam made by the dancing cover of the tea kettle makes the steam engine, in a measure, intelligible; but the operation of the electro-magnet awakens no feeling of understanding, and all we can say, after years of experience with it, is that it has grown common, and for that reason only does it fail to excite emotions of wonder. The invention of Professor Morse served the world for many years in pretty much its original form, but at last changes began to appear, and each new step seemed almost as marvelous as the first. The "duplex" made us acquainted with the fact that two signals can pass each other on a single wire without confusion. To be acquainted with a fact is not necessarily equal to an understanding

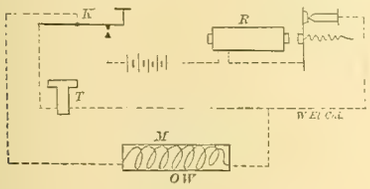


Fig. 1.

of it, and but little time was allowed for the comprehension of the "duplex", when the "quadruplex" brought fresh mental burdens. Scarcely was the "quadruplex" in the field, when the telephone was announced. It was said that the human voice had actually been made to pass over a wire. The truth of the assertion lives in the business and social world to-day. Now another step has been taken and the result is a marvel within a marvel. This last step consists in sending messages to an operator upon a train of cars in motion. Previous to and including the introduction of the telephone, a complete electric circuit had been considered essential to telegraphic communication, but the new-comer does its work through several feet of air space, and persons who thought they had got about down to "hard pan" in electrical puzzles, find themselves in the fog once more.

One man who had a fair idea of plain telegraphy made a little "fun for the boys" by his strong assertions that the train telegraph was absurd. He had seen a diagram of connections such as are used on the train, in one of the induction systems, and had done practical service before it was examined by the expert in question. Our friend traced the circuit from the track up through the operator's set to the tin roof of the car, and there he reached a break. That settled it. He had traveled many a weary mile to join the ends of broken wires, and was not ready to admit that his hard work had been in vain.

The pioneer names connected with the system of which I write, are Lucius J. Phelps and William Wiley Smith. Messrs. Edison and Gilliland have taken a leading part in making practical applications, and have secured some claims on their own account. Mr. Phelps devoted himself to the principles involved in dynamic induction, while Mr. Smith turned his attention toward static induction. Mr. Phelps used a wire laid inside of a wooden stringer running on the ties between the rails. The Smith system does good work by the aid of existing telegraph lines and the tin roofs of passenger cars. I can not, in this article, cover all the ground passed over by the gentlemen mentioned, but will try to give a fair idea of the work of each.

I have said that Mr. Phelps placed his main line inside a wooden stringer between the rails. This wire was grounded at the ends, and worked as a closed circuit. One method of car equipment, was to place an electro-magnet under the body of the car, fastening the magnet in such position that it would run at right angles to and as near the track wire as possible. A current passing in the track wire, would tend to magnetize the core of the magnet on the car and produce a current in the surrounding wire. In Fig. 1 *W* is a sectional view of track wire; *K* double point key; *T* hand telephone; *R* back contact relay; *M* magnet running near wire *W*. The key open, closed the circuit through the hand telephone, and was in a position to receive. The key, pressed to its front stop, closed the circuit through a small battery and the relay, including the back contact, producing a buzz which went into the track wire by induction. This diagram of connections is correct for the track wire when magnet *M* is omitted. Mr. Phelps's first idea was that he could use polarized relays and sounders in his work, but experience did not bear him out. He substituted a hand telephone for the polarized relay and made his signals with the buzzing current mentioned. I witnessed the operation of this system on the N. Y., N. H. & H. R. R. The track is double, and the wire was laid only on one track. The signals were clear and good, but much the best when the train was running directly over the main wire, as might be expected.

The system devised by Mr. Smith is peculiarly interesting in that it grew out of the inventor's observations upon cross talk. It is a fine illustration of the fact that natural principles may be hurtful in one field and helpful in another. In describing this system, I will refer specifically to the arrangement used at the exhibition given on Staten island, in February, 1886. The road extended from Clifton to Tottenville, thirteen miles. The B. & O. Telegraph company had a line of thirty wires along the track. Five wires were chosen for the train telegraph. To these five wires half connections were made. Each of the branches thus formed was carried to a condenser of very small capacity. Fig. 2 shows the manner of using the branches. *K* is a double contact key; *T*, hand telephone; *M*, magnet, having only a primary winding of low resistance; *V*, vibrator kept in motion by local battery not shown; *B*, small battery; *C′ C″ C‴ C⁗ C′′′′′ C′′′′′′* are condensers. The action of the condensers was to reduce the confusion in the telephone, caused by the regular work of the wires, and also to prevent the arrangement from interfering with the regular work. There were several systems working over the wires during the day, and the confusion was great when listened to in the telephone. The condensers discriminated in favor of the train telegraph, causing the signals to stand out alone. I shall never forget my sensations when this style of connections proved successful. I was working upon the experiment in company with my friend S. K. Dingle of New York. I was at the station, Mr Dingle making the run from Clifton to Tottenville. Upon the day in question, the run to Tottenville had proved very unsatisfactory. I lost communication almost immediately after the train left Clifton. It was in the middle of the day and the wires were heavy with work. I strained my ear

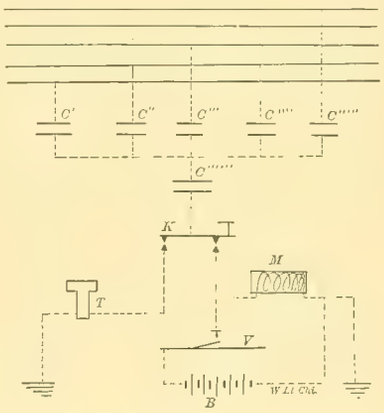


Fig. 2.

to catch Mr. Dingle's signals, as long as the train was on the road, and then settled back in my chair to wait for the return trip. I had no particular desire for the return trip either, as I had no hope of better results. But something had to be done. Time was passing, anxious eyes were upon us, and failure was not to be thought of. We had used a single wire and the idea came to me to try a combination of wires and condensers. I was aroused for the plan seemed to have some merit. I quickly made the necessary connections and then eagerly waited for the train to start back. When the hour arrived, I was listening at my telephone, and heard what I thought was some new sort of work passing upon the wires. It was a straight buzz, unlike anything that I had heard before. I listened intently, and after a moment or two, the buzz broke into Morse signals. It was "D" calling "R". I reached for my key, and did not lose communication with Mr. Dingle until the train pulled into the station at Clifton, where the tin roof on the shed cut us off. The straight buzz which I heard, was "D" adjusting.

The connections used on the train were as shown in Fig. 3, in which *T* is the hand telephone; *K*, double point key; *C*, regular induction coil—the fine wire being represented by the wave line and the coarse wire by the straight line; *V*, vibrator kept in motion by magnet and local battery not shown. The key on the back stop closes circuit from roof through telephone to ground, the ground being reached through the metal work of the car under the floor. The key pressed to the front stop closes the circuit from roof through fine wire of coil *C* to ground.

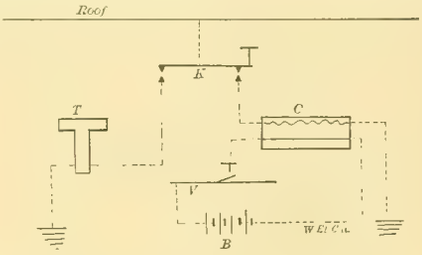


Fig. 3.

Battery *B* passes through the vibrator points and the coarse wire of coil *C*. The tone of the vibrator is reproduced in the coil, and passes to the roof when so desired for signaling. Many experiments were tried to get just the right kind of coils. We settled on the plain primary for use in the station, and a regular induction coil for the car. It seemed to be necessary to charge the roof to a higher degree than was required for the wires. I think the track exerted more influence upon the roof than upon the wires, so that the roof had to sustain a heavier tax upon its inductive energies than the wires. At any rate, it was easier to work from the station to the train than from the train to the station.

The operation of Mr. Smith's system depends upon the condenser action taking place between the tin roof, or roofs, and the neighboring wires. With the arrangement which I have described, a charge passing to the roof is greater because of the nearness of the wires; and by just so much as this charge is greater, is the strength of the train signal measured. When using the existing lines as a part of this system, it was customary to connect all the available roofs of the train together, to increase inductive surface.

Late in the year 1886, some experiments were made in western Iowa, on the C., M. & St. P. R. R. Mr. Dingle and I were still together, and had a construction train assigned to us. Instead of tin roofs we were obliged to use a flexible, insulated cord, strung on stakes set in the cars. This cord was left open at the distant end and connected to the apparatus in the caboose, just as a wire to a roof would have been connected. We did some very good work with this train. As a general thing the construction train had been working under cover of a flag or upon the best orders that could be given at the time of its departure from a telegraph station. When our arrangements were completed, we were able to follow the train wherever it might be working, and give it the advantage of any change in circumstances that favored it, or get it out of the way of unexpected trains if necessary. In some cases we held communication over a space of one hundred and twenty-five feet between the lines and the train.

At this stage of our work we came upon an unexpected enemy. One morning we began work as usual and all went well. The train worked in a quite deep gravel pit over a hundred feet from the wires. I was in the dispatcher's office and Mr. Dingle was on the train. About 10:30 a. m. I noticed a peculiar sound in the telephone and wondered what new system of electrical work was operating in Omaha. In a little while the noise became troublesome. It would begin light and rise to a maximum, mak-

ing a little explosion when it reached its highest point. These explosions would frequently cut a word out of something which the train was trying to say to me. This trouble grew worse until noon, but when the train pulled up out of the pit, the margin was good enough to work over the noise. Up to noon the wires had been working smoothly. The weather was warm with a southwest wind blowing, and the sky filled with banks of fleecy clouds. I had no thought of atmospheric disturbance until shortly after noon, when the Morse relays began "clipping". The explosions in the telephone followed each other in quick succession, and work with the train ceased. Soon the switch-board began to flash fire, and the work on the wires was hard. Between 2 and 3 o'clock we had a raging storm, with severe lightning and thunder. The fact was, I had received in the telephone, intimations of the storm some considerable time before the relays were in the least affected.

Time has wrought changes. I no longer telegraph through the air, but am back again into more common pursuits. Mr. Dingle still follows the fortunes of the train telegraph, and is meeting with marked success on the Lehigh Valley road. A special wire has been built there, and placed as near as safety will permit to the tops of the cars. A strong margin is thus secured, and now the system is slowly fighting its way into notice, just as each of the other electrical improvements have done.

Not so Much of a Game Preserve.

There has been a run on the Bedloe's island boat, says a New York paper, ever since the story got around that brant and geese and canvas-backs were beating their brains out every night against the electric torch of the Goddess of Liberty, and falling at the foot of the pedestal in heaps big enough to make the head of a Washington market dealer swim. With ducks

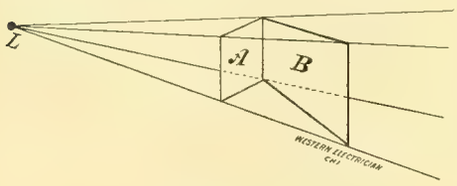


Fig. 2.

$4 a pair and prices stiffening many rusty looking sportsmen from the lower wards stole down to the island fitted out with hunting baskets and big inside coat pockets.

Bedloe's island in fact isn't much of a paradise for sportsmen or epicures, and there is no danger of the Madison square preserves being abandoned yet. Lots of rails, sparrows, wrens, catbirds, orioles, and woodpeckers have been killed by flying against the goddess's torch at night. But such small fry are scarcely worth picking. So far not a single duck, goose, partridge, snipe, or reed bird has been found on the island dead or alive.

From Oct. 1st, an accurate record has been kept of the number and kinds of birds killed against the light. One hundred and seventy-five wrens were found on Oct. 12th. Fifty rails, eleven wrens, two cat-birds, and one whip-poor-will were picked up on Oct. 1st. On the last four or five days no birds at all have been found, and the total for the month so far is only 432. Cloudy nights generally bring more victims than clear ones, yet there are some curious exceptions. The night of Oct. 1st, when sixty-five were killed, was rainy and windy. But the night of Oct. 16th when 175 were killed was perfectly clear.

No sea-birds have been picked up, which points plainly to the migration of the colonies of small fry from north to south each fall as the chief cause of the havoc. The birds flying across the bay at night are first drawn toward the big electric torch by its brilliancy and then are blinded by its rays at close quarters. They dash against the glass plates in the flambeau just as they would against a house window, and either knock their brains out outright or are stunned and killed by the fall.

The Proper Height and Distribution of Electric Lamps for Illumination.

By F. B. Badt.

"The intensity of illumination, or the quantity of light received on unit surface, is inversely as the square of its distance from the source. When the light falls obliquely, the intensity is proportional to the cosine of the angle which the rays make with the normal to the surface."

In Fig. 1 L is supposed to be the source of light, R R R R rays of light, and A, B and C surfaces,[1] placed at right angles to the rays of light. A is placed at a distance of 1 unit, B at 2 units and C at 3 units.

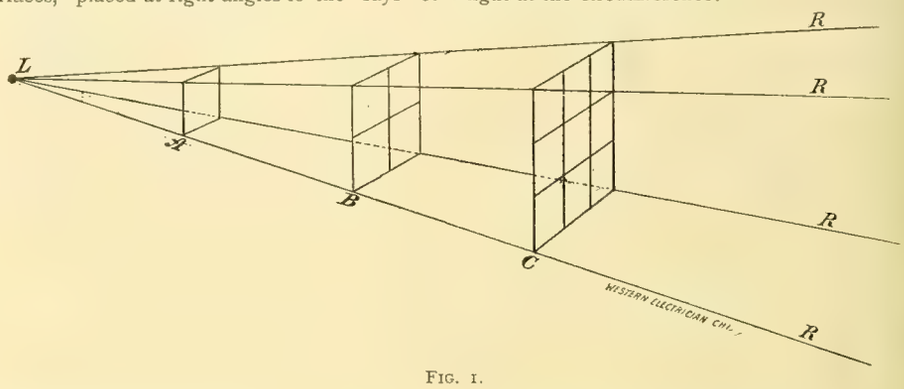


Fig. 1.

If A, B and C each receive the same quantity of light, it is clear that if we call A the unit surface, the same quantity of light will be distributed over four times the surface at B and nine times the surface at C; or in other words, if we set the intensity of the light at $A=1$, it will be $\frac{1}{4}$ at B and $\frac{1}{9}$ at C.

In Fig. 2 A is a surface placed vertically to the rays of light and B obliquely. It is obvious that even at the same mean distance from L the oblique surface B will be larger than the vertical surface A. Hence the intensity of the light must be smaller in B than in A.

To express this in the terms of the foregoing law let us consider D C in Fig. 3 as the oblique surface; L the source of light; angle x (B L C) the angle which ray L C makes with the normal L B.

The greater the cosine of x, the greater the intensity of light on D C. Cosine x is greatest when x equals 0 degrees, and smallest when x equals 90 degrees. Cosine 0 degrees equals 1.0000; cosine 90 degrees equals 0.0000; hence, the smaller the angle x the better the illumination, and *vice versa*.

Fig. 4 shows an example for the application of both laws. B is the object to be lighted. When it is lighted by light L^1 the illumination will be weak on account of the obliqueness of the rays of light. We raise the light to L^2 and again the illumination is weak on account of too great a distance between the object and the source of light. The task is now to find the position of the light in the vertical line $L^1 L^2$ where the object B will be lighted most intensely at the same horizontal distance.

Professor Hoffmann [*Electrotechnische Zeitschrift*, March, 1881,] has found by means of calculus a rule for this purpose which says: "The source of light should be located above the center of a circle whose circumference shall be lighted best from a source at a height of about $\frac{7}{10}$ of its radius." He shows that in practice it is not necessary to find the proper height to obtain the greatest quantity of light on a given *surface* but to find the height of L above the center of a circle whose *circumference* shall be lighted best. In Fig. 4, L A (h) must be equal to about $\frac{7}{10}$ A B (r). Angle A L B is then about 55 degrees.

Professor Hoffmann deducts furthermore the following formula for the maximum intensity of light at the circumference:

$$\text{Maximum intensity} = \frac{4\,\pi i \sqrt{3}}{9r},$$

in which π stands for 3.1416; i stands for the quantity of the ray of light at the distance $=1$; r stands for the radius of the circle.

The above rule is only true for one single light.

For a row of lights and under the condition of an even illumination of the ground, according to Upperborn: $h_1 = 1.5h$; $r_1 = 1.5r$; D (distance between two lamps) $= 2r_1$ or $= 3r$.

If, therefore, we know from practical experiments h and r of one lamp of a certain candle power, we can easily calculate h_1 and r_1 or D for a row of lamps.

If a large surface has to be lighted, of course, two or more rows of lamps are to be put up

If the space is rectangular every four lamps will form a square (Fig. 5) of which the diagonal $D\triangle$ will be parallel to the sides of the space. It is more convenient to use $D\triangle$ for calculations. It is the hypothenuse of a rectangular triangle of which the other sides are $= D$ or $= 3r$; hence $D_1 = 1.4\,D = 4.2r$.

The following table from Upperborn, gives the necessary figures to calculate the proper height and distribution of lamps of any candle power, provided h and r have been determined practically for a lamp of the intensity i. This table can generally be applied only for streets and squares; for factories, stores, etc., other circumstances must be considered:

ONE LAMP.			ROW OF LAMPS.			AREA.	
Intensity = i	Height = h	Radius = r	Height = H	Radius = R	Distance = $\frac{D}{2}$ =	Distance = $\frac{D}{2}$ =	Diagonal $\triangle$
$1\,i$	$.7r_1$	$r_1 = 1.0r_1$	$1.1R_1$	$R_1 = 1.5r_1$	$3.0r_1$	$3.0r_1$	$4.2r_1$
$2\,i$	$.7r_2$	$r_2 = 1.4r_1$	$1.1R_2$	$R_2 = 2.1r_1$	$4.2r_1$	$4.2r_1$	$5.9r_1$
$3\,i$	$.7r_3$	$r_3 = 1.7r_1$	$1.1R_3$	$R_3 = 2.6r_1$	$5.2r_1$	$5.2r_1$	$7.3r_1$
$4\,i$	$.7r_4$	$r_4 = 2.0r_1$	$1.1R_4$	$R_4 = 3.0r_1$	$6.0r_1$	$6.0r_1$	$8.4r_1$
$5\,i$	$.7r_5$	$r_5 = 2.2r_1$	$1.1R_5$	$R_5 = 3.3r_1$	$6.6r_1$	$6.6r_1$	$9.2r_1$
$6\,i$	$.7r_6$	$r_6 = 2.4r_1$	$1.1R_6$	$R_6 = 3.7r_1$	$7.4r_1$	$7.4r_1$	$10.4r_1$
$7\,i$	$.7r_7$	$r_7 = 2.6r_1$	$1.1R_7$	$R_7 = 4.0r_1$	$8.0r_1$	$8.0r_1$	$11.2r_1$
$8\,i$	$.7r_8$	$r_8 = 2.8r_1$	$1.1R_8$	$R_8 = 4.2r_1$	$8.4r_1$	$8.4r_1$	$11.8r_1$
$9\,i$	$.7r_9$	$r_9 = 3.0r_1$	$1.1R_9$	$R_9 = 4.5r_1$	$9.0r_1$	$9.0r_1$	$12.6r_1$
$10\,i$	$.7r_{10}$	$r_{10} = 3.2r_1$	$1.1R_{10}$	$R_{10} = 4.7r_1$	$9.4r_1$	$9.4r_1$	$13.2r_1$

For instance it was found that a lamp of 50 candle power would light the circumference of a circle of the radius $r_1 = 30$ feet at the desired intensity, then the height $= h_1 = .7 \times 30 = 21$ feet.

A 100 candle power lamp would light equally well the circumference of a circle of the radius $r_2 = 1.4 \times r_1 = 1.4 \times 30 = 42$ feet, and the proper height would be $= h_2 = .7 \times r_2 = .7 \times 42 = 29.4$ feet.

1. These surfaces are in fact, not planes as shown in the sketch, but parts of the surfaces of concentric spheres.

And again, if we should want to put up a row of 16 candle power lamps and light the ground uniformly and equally well as above:

$R_1 = 1.5\, r_1 = 30 \times 1.5 = 45$ feet.

$H_1 = 1.1\, R_1 = 45 \times 1.1 = 49.5$ feet.

D (distance between two lamps) $= 3\, r_1$ or $= 2\, R_1 = 45 \times 2 = 90$ feet.

If we wanted to light a surface as shown in Fig. 5:

$D_1 = 3r_1 = 3 \times 30 = 90$ feet.

$D\triangle = 4.2r_1 = 4.2 \times 30 = 126$ feet.

For incandescent lamp installations the following table will give an approximate idea of the number of lamps required for general illumination. For ball rooms, theaters, and like places of public assembly, the number of lamps should be doubled, calculating one 16 candle power lamp for about 700 cubic feet. In rooms of more than 30 feet height the lowest point of the electroliers should be one-third of the height of the room above the floor:

Dimensions of room in feet.			Number of 16 candle power incandescent lamps.	Height of lowest point of electroliers above the floor, in feet.
L'th	W'th	H'ht		
15	15	12	2	6
18	18	14	5	7
24	24	16	9	8
32	32	22	16	9
40	40	30	25	11
50	50	40	40	13
60	60	45	60	15
70	70	50	100	17

Arc lamps are generally run from continuous current dynamos. A crater is formed in the positive carbon and most of the light is reflected

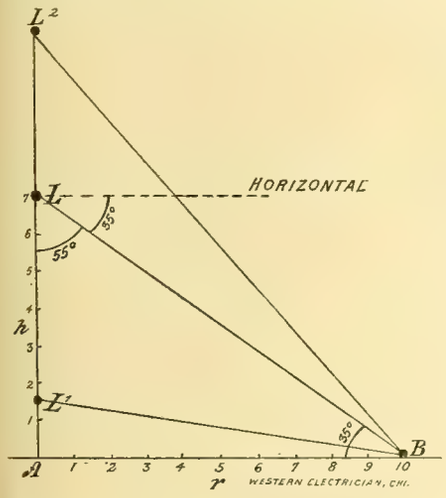


Fig. 4.

downwards. Fig. 6 shows the distribution of light from an arc lamp. It will be seen that the greatest intensity of illumination takes place at an angle of about 37° with the horizontal $O\,B$. This angle coincides very nearly with the theoretical angle for best illumination of 35° as shown in Fig. 4. A reflector placed above an arc lamp will for the same reason be of little value. Fig. 6 also explains why it is very difficult to determine the exact candle power of an arc lamp. A good nominal 2,000 candle power arc lamp measures horizontally about 250; at an angle of 37° with the horizontal about 2,000 and on an average (mean spherical candle power) about 450 normal candles.

Glass globes will alter the distribution of the light. Curve *a* in Fig. 6 represents the diffusion of the light of the naked arc; curve *b* through an opal and curve *c* through a ground glass globe. The absorption of light is from 30 to 40 per cent. through light opal, 25 per cent through ground glass and 10 per cent. through clear glass globes.

R. E. Crompton gives the following table as a result of practical tests with a 4,000 candle power lamp:

Horse Power expended in the arc.	Height of Lamp above ground, in feet.	Area of Illuminated ground, in square feet.	Intensity of Illumination.
2½	16	2,500	1
2½	18	5,000	1
2½	20	10,000	2
2¾	40	20,000	2
4	40	70,000	3
4	40	80,000	3

The intensity of the illumination refers to the circumference of a circle of the illuminated area. At intensity 1 every kind of fine work can be done which otherwise requires a 12 candle power gas burner at a distance of 22 inches; at intensity 2 one can read a newspaper easily; intensity 3 is about equal to the illumination of a full moon.

The following data may be used for estimating the number of arc lamps required to light a certain area:

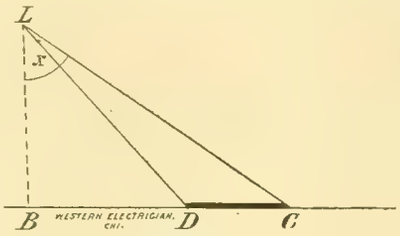


Fig. 3.

	Area which can be lighted by one nominal 2,000 candle power arc lamp.
Yards	20,000 square feet
Railway Stations	15,000 " "
Foundries and Rolling Mills—General Illumination	5,000 " "
Foundries and Rolling Mills—Special Illumination	2,500 " "
Dyeing Establishments	2,000 " "
Printing Establishments	1,500 " "

For the best illumination of streets arc lamps should be suspended over the middle of the street. If placed at a height of about thirty feet and at a distance of 200 feet apart, they would, for instance, light State street in Chicago about six times better than under the present method of illumination by gas. In fact, if the arc lamps should be placed higher than 30 feet it would still improve the illumination, but 30 feet would probably be the limit from practical reasons.

Dr. Hagen's remarks ["Electric Lighting in the United States," by Dr. E. Hagen, Berlin, 1885] concerning tower and mast lighting are *apropos* at this point:

"It has been calculated that in order to get the the best effect a lamp should be placed at a height of .7 of the radius of the circle to be illuminated. Though this is perfectly correct, the American way of placing a number of lamps—from five to eight—on a high tower or mast must be considered entirely wrong. The light reflected by the lamps towards the mast is almost lost for illumination. Streets which run towards the mast are fairly well illuminated while the streets running at right angles appear perfectly dark. Arc lamps, of course, should be located considerably higher than gas lamps but tower lighting is going into the extreme It might possibly be allowed for the lighting of large squares, though even in this case the proper distribution of lamps at less height would be preferable."

The doctor's ideas seem to have been realized in New York where, according to a paragraph in the last number of the WESTERN ELECTRICIAN, the city authorities have abandoned electric light towers in Madison and Union squares and will put in their place 23 arc lamps on poles dis-

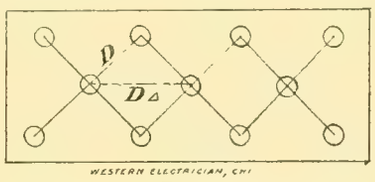


Fig. 5.

tributed along the walks. The main fault found with the lights on the high towers was that they did not penetrate the thick foliage in the more remote parts of the squares.

Priority of Invention for Campbell.

The winning of a suit against the Bell telephone company is such a novelty in the legal arena, that when the feat is performed an especial mention is well earned, says the Boston *Herald*. This has been done by Henry F. Campbell, an inventor. This case was a matter of interference between the applications of William W. Jacques and Henry F. Campbell, and the case came before the examiners-in-chief on appeal. In this case Jacques really meant the Bell telephone. Jacques' claim was filed August 23, 1883, and Campbell's September 21st of the same year. Jacques got ahead of Campbell in filing his application, and appears to have been determined to get clean around him in every way. It was as early as the spring of 1882 that Campbell conceived the notion of putting an external shield of iron, or some material of a paramagnetic character, on the insulating covering of the conducting core of an electrical conductor. He disclosed his thought to others, and set about making persistent and elaborate experiments. He employed an assistant, to whom he confided his theories. His first paramagnetics were applied as paint; then he tried soft plate iron, wound spirally; then tinned iron tape; then soft iron wire; afterward iron ribbon strips, wound spirally in both directions. This last expedient was adopted not later than May, 1882, was tested and found satisfactory, and it was filed in evidence. Campbell's assistant testified that almost every metal and a great variety of other substances were experimented with. The success of the tests moved Campbell to try experiments and conduct tests with long wires, and he prepared several, some of them 400 feet long. The first of these tests was made in Boston, March 27, 1883, and they were continued through April. In view of the satisfactory results obtained, Campbell was urged to take these long wires to the laboratory of Jacques. Some of the wire taken to Jacques was covered with soft iron ribbon, but it appears that Campbell, although using pure, soft iron, had not at that time discovered its

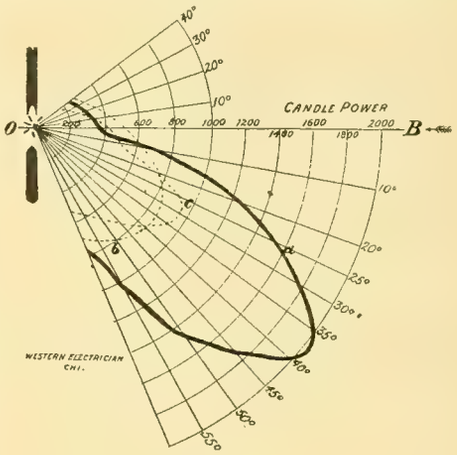


Fig. 6.

superiority to hard iron or iron alloys. Here was the small hole through which Jacques tried to creep in the endeavor to outwit the real inventor. The tests were satisfactory, the wires were left in custody of Jacques, and he at once reported favorably to the Bell company. On May 26th, Campbell being urged thereto by interested parties, did, under solemn pledges of confidence, disclose to Jacques his secret. Jacques did not claim to have conceived of the invention prior to this date. The examiners-in-chief say: "The claim of inventorship on the part of Jacques seems to be based wholly on the theory that Campbell did not fully appreciate the excellence or superiority of pure soft iron at the time of disclosure, and that it was left to Jacques to pick up and appropriate to himself the claim to pure iron." By some disingenuous influence, Campbell was induced to file a claim, prior to the present one, in June, 1883, claiming an anti-inductive envelope of paramagnetic and diamagnetic substances in connection. So far as this went to prejudice his claim to the real invention the examiners say: "Whatever motive operated to induce Campbell to first file his claim for paramagnetics and diamagnetics combined, he did not by that act forfeit or abandon his right and title to a paramagnetic envelope, as he now claims it. Campbell was first to conceive, first to experiment, first to disclose." The examiners complete their opinion as follows: "We see no standing for Jacques as an inventor in this case, and must award priority of invention to Henry F. Campbell, affirming the decision of the examiners of interferences."

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THE use of electricity for heating has been the subject of some thought on the part of electricians and its practical application has been the reiterated promise of a near future. Perhaps few have thought, however, that an electric stove would be evolved out of a dozen incandescent lights, but the fact is shown on another page.

THE next meeting of the American Institute of Electrical Engineers, in New York, will be held December 6th. William Stanley, jr., electrician of the Westinghouse Electric company, will read a paper on "The phenomena of alternating currents." The subject is an exceedingly interesting one and in the hands of as eminent an electrician as Mr. Stanley will unquestionably receive thorough treatment.

CHICAGO is tired of at least one "trust"—the Gas trust—and its city council at the meeting of Monday evening last passed this order by a large affirmative vote: "Be it ordered by the city council of the city of Chicago that the mayor of the city of Chicago be requested to invite the city attorney general of Illinois to apply for a *quo warranto* in the proper court against the Chicago Gas Trust company, the Consumers' Gas, Fuel & Light company, the Equitable Gas-Light & Coke company, the People's Gas-Light & Coke company, and the Chicago Gas-Light & Coke company, for the purpose of forfeiting the much-abused charters of the aforesaid corporations, and that the law department of the city of Chicago be directed to furnish said attorney general of the state of Illinois all information and aid which it can render in prosecuting the *quo warranto* aforesaid."

THE collation of a score of excerpts from the daily press, given on another page, all bearing favorably upon the institution of a postal telegraph is an indication of the pulse of the country, and is timely, in view of the measures that leading members of congress announce they will introduce in the fiftieth congress to that end. Never, perhaps, were the people more in favor of a governmental control of the telegraph, or rather a telegraph controlled by the government, than at present. The irresistible power of a huge consolidation of capital in the hands of a single company, governed by a single man, has recently swept away a powerful competitor, and, practically, the telegraph business of the country is again in the hands of one company, and at prices that seem fit to that company, whether regarded as extortionate or not by the user of the telegraph.

Grave questions will arise in considering and settling the matter whether the government shall control the telegraph of the country or a telegraph, and the subject as indicated by the extracts given is awakening, and will awaken, careful thought and attention.

THE subject of a submarine telegraph across the Pacific ocean, which has been under discussion for some time, is just now attracting the attention of the daily press. The importance of such a line to the Sandwich islands and other groups in the Pacific on the proposed route, which are now isolated, is apparent. The great empire of Japan, which is now adopting the various modern improvements, including the telegraph, telephone and electric light, is especially interested in this matter. Such a line would also be of great advantage to the United States, for while we have ample connection with the eastern continent and Great Britain through Atlantic cables, we still need a direct line to Japan instead of a circuitous one through the eastern continent, involving numerous repetitions of messages with consequent delays and mistakes, and the liability to frequent interruption by war between some of the various countries through which they must pass. The route has been surveyed, and a favorable location selected, the only exception being near the coast of Japan where the ocean's depth is six miles. The numerous groups of islands in the Pacific practically reduce the distance for each submarine line, so that this route, so far as distance is concerned, is approximately as feasible as that of the Atlantic, but the average depth of the ocean is probably greater.

THE mercurial fire alarm has proved its value in three signal cases in Chicago recently. One was in the Chicago club building. The insurance patrol received the alarm first over the wires connecting with the mercurial alarm, and they sent in the city alarm. The fire had got under such headway, however, that it burned out two floors. There is no question that if the mercurial alarm had not been in use club members and the servants who were sleeping in the building would have been unable to escape, and another holocaust would have been recorded. The second case was also in a club house—that of the Union League. The ever watchful mercurial alarm called the insurance patrol in time to prevent any but a slight damage to the building. The third was in the Saratoga hotel, noted last week.

While the mercurial alarm has been in use for some years, and has become so common that little attention on the part of electricians is attracted to it, yet one is compelled at such exhibitions of usefulness to stop for a moment and give it commendation. Though this alarm is regarded as one of the minor applications of electricity, it frequently plays a highly important part in the world's affairs. For weeks, or months, or even years, it may stand the silent, overlooked, forgotten sentinel, but in the crisis, it springs to sound its warning, and then for the moment attracts the world's attention and admiration.

B. E. SUNNY replies in our columns this week to the sweeping, sarcastic editorial of the *London Electrician* on his paper read before the recent telephone convention.

It was our opinion at the time that the facts, as presented, were liable to be misunderstood, but we regret that our highly esteemed contemporary should have so far departed from its usual spirit of fairness and courtesy with reference to American electric work. Perhaps one of those celebrated London fogs may have temporarily beclouded its mental perception. However this may be, it is to be hoped that Mr. Sunny's reply, if somewhat tart, as might have been expected, will dispel the mist and be a sufficient vindication of Chicago telephone work, especially of that which pertains to underground lines. This subterranean work has been in progress here for several years, and its magnitude during the present year gives evidence of assured success. The immense number of cables branching out in every direction from a central point near the City hall, leads one to wonder where room can be found for them all. The tunnel system alluded to in this connection, would probably be found the cheapest and most practical, all things considered, which could be adopted, though requiring a heavy expenditure at the outset. A well built tunnel of sufficient capacity for all underground work of every description, including electric cables, water mains, gas mains, and possibly street cars, would solve the whole problem of street obstruction, would save the constant expense of excavation and refilling for new lines and repairs; faults could be located and repaired with comparatively little trouble and expense, and the pavement, once put down, could remain undisturbed till worn out.

PROFESSOR Badt's article on the proper height and distribution of electric lamps for illumination, is of practical interest and deserves attentive perusal. It is quite as important to prevent waste in the distribution of light, as in its production. A parallel to this is found in the distribution of heat, and the great variety of devices for economizing heat, and concentrating it where it is required, shows that the importance of the subject is duly appreciated; but the proper distribution and concentration of light seems to have received less care. The mathematical demonstrations, based on the well-known law of inverse squares, are evidently far from being mere theoretical deductions; the writer is engaged in practical work, and makes his estimates from a practical stand-point, and consequently his formulæ and tables are of high practical value. His reference to the percentage of absorption of light by different kinds of globes, is also a matter of practical interest which will bear further amplification. Light absorbed is practically wasted. Take the case of a large factory lighted by arc lamps and running night and day; if, as is usually the case, the walls and ceilings are allowed to become coated with grime, we may reasonably assume that ten to twenty per cent. of the light produced is absorbed, entailing a loss in the cost of illumination, which might be saved by a trifling expenditure for calcimine, which would reflect and diffuse the light and reduce the intensity of the shadows so often a cause of complaint in the use of arc lamps.

WITHIN a fortnight the American Bell Telephone company has taken steps to break the deadlock that has existed for twelve months between it and the telephone subscribers at Rochester, N. Y. A year ago the telephone company proposed to substitute toll rates for a flat rate in that city but the rates were regarded as exorbitant by the subscribers and they quickly resolved themselves into an association, decided to hang up their telephones and not take them down again until the telephone company made terms that were acceptable to the former. The telephones are still hanging on their hooks for, though the Bell company has made overtures to the telephone subscribers, at present the dead-lock is unbroken.

The collision between the telephone company and the subscribers was unfortunate in more ways than one. First, it has shown that the telephone is a luxury and not an absolute necessity in all cases; that if the telephone ever goes into use in Rochester again many will decline it and thus render the exchange the less valuable for the less number of connections it presents a subscriber. For a year a valuable plant has lain idle and earned nothing or not enough at any rate to make a showing. Probably the loss suffered by the wealthy American Bell Telephone company as a stockholder in the local company, in the discontinuance of the business of the latter, was not great enough to cause it any serious inconvenience; probably, in fact, was not noticed, but with the other stockholders the case was different. Meantime there have been outbursts of popular indignation at what has been termed the rapacity of the American Bell Telephone company in other cities in other states.

It seems to us that the root of the whole trouble lies in the exorbitant royalties demanded by the parent company. By the time the earnings of an exchange are divided into royalties to the Bell company, dividends to the Bell company, and then dividends to the other stockholders, there is generally only a small percentage left for the latter. A royalty of less amount would have an immediate effect upon the reduction of telephone rates, and by that very reduction there would be an increase in the number of subscribers—increasing naturally the income to both the local and the parent telephone companies, and with each subscriber added to the list the telephone would lose some of its character as a luxury and become more of a necessity.

The Elements of Electric Lighting.

By Philip Atkinson, Ph.D.

Number XX.

Electric Induction Continued.—The induced current, as has been repeatedly stated, is a momentary transient impulse which occurs at the instant an electric circuit is either opened or closed; its direction on the opening of the circuit being the reverse of that on the closing; and the continuous current of the dynamo, whether constant or alternating, is composed of a series of these impulses, induced not by the opening or closing of the circuit, but by a reversal of the position of the coils of the armature by their rotation and consequently of the relative direction of magnetic induction.

In the case of transformers, as has been shown, the primary circuit is opened and closed successively, with great rapidity, by a circuit breaker, and the series of impulses constituting the current, in the secondary circuit induced thereby. It is found that the current induced by the opening of a circuit is far more powerful than that induced by the closing. This would seem to be the natural result of the sudden check of the accumulated energy flowing through the conductor, while on the opening of the circuit the rise of the circuit to its full strength is, in a certain sense, a gradual process, aptly expressed by the term lag. The current induced by the opening has been generally termed extra, but as this term has no special significance, except as it may refer to extra strength, it is falling into disuse. In the case of accidents requiring the sudden stoppage of the dynamo, it is of the highest importance that the greater energy of this current should be guarded against by suitable construction, such as a short circuiting switch or other similar device.

In concluding these remarks on the nature and general principles of induction, which have been thus briefly indicated, it should be stated that when we consider that induction permeates every portion of every electric instrument, its force radiating from every charged conductor, the great importance of a thorough comprehension of its principles and their application becomes evident. It must be recognized not as an obstacle to be overcome, though it often stands in the way of desirable ends in construction, but as an important factor in the accomplishment of electric work, without which the construction and operation of the existing forms of electric apparatus would be an impossibility; and it is coming to be understood that it is better always to recognize it as a friend than as a foe.

Conductivity and Insulation.—Conductivity is that quality of a body which facilitates electric transmission; insulation is its opposite, and obstructs electric transmission. The distinction between the two when applied to bodies is one of degree, the one being the reciprocal of the other. There is no well defined boundary showing where conductivity ceases and insulation begins; every conductor is an insulator so far as it tends to resist electric transmission, and every insulator is a conductor so far as it tends to facilitate such transmission. Where conductivity is found to predominate as in the metals the term conductor is applied, and where insulation predominates as in glass and vulcanite the term insulation is applied. The terms high and low are applied to conductors to designate different degrees of conductivity, or, conversely, different degrees of resistance; and to insulators to designate different degrees of insulation. Silver and copper for instance are metals of the highest conductivity, and conversely of the lowest resistance; bismuth and German silver have high resistance and consequently low conductivity. Glass and vulcanite have high insulation and correspondingly low conductivity, so low that the term conductor is never applied to them, nor is the term insulator ever applied to silver or copper. Hence a conductor is any substance of such low resistance that it can be used practically for the transmission of electricity; and a non-conductor is any substance of such high resistance that it can be used practically to prevent such transmission.

Difference of molecular constitution is the most reasonable explanation that can be given of these different phenomena, but just how such difference produces these varied results is unknown. But we may reasonably attribute them to difference in molecular arrangement. If we compare the molecules to an infinite number of infinitesimal tubes, and electricity to a fluid passing through them, it is evident that were these tubes placed end to end, in series, the flow would be facilitated, but if disposed traversely, or in a heterogenous manner, the flow would be obstructed. Similarly we may suppose the relative arrangement of the molecules in one substance to be such as to facilitate, and in another to obstruct electric transmission. If, as seems highly probable, electricity is a mode of molecular motion by which energy manifests itself, the above explanation seems entirely reasonable; difference of arrangement or difference of shape in the molecules, or both combined, producing differences in the mode of interaction.

Quantity and Intensity.—The comparatively imperfect state of electric knowledge has led to a misuse of the terms quantity, intensity, and strength as applied to current, each writer using them according to his own mental conception of the facts, or carelessly following the general custom. Whatever current may be, its quantity, as observation proves, must be regarded in the same light as that of any physical quantity, so that whether we consider it as energy flowing through the conductor as its passive medium, or as producing molecular motion in the conductor itself, as already explained, it has a certain volume in the same sense as a fluid—water or gas—flowing through a pipe; and this volume, as in the case of fluids, is dependent on the resistance encountered and the pressure urging it forward, known as e.m.f. With a given conductivity and e.m.f. any increase of cross-section by the substitution of a larger conductor, or a greater number of conductors, produces an increase in the quantity or volume of the current, and a corresponding decrease of intensity at each point in its cross-section, by distributing the original intensity over a larger area; and a reversal of these conditions produces the opposite effect. Conversely with a given conductivity and cross-section in the conductor, any variation in the e. m. f. produces a corresponding variation of intensity.

Electric intensity has been regarded as analogous to momentum; but since momentum is the product of mass and velocity, and since mass is not a factor in electric intensity the analogy fails. But if we regard electric intensity as the result of molecular movement in the conductor, produced by e. m. f., we shall probably come nearer the exact truth.

It has also been assumed that the constancy of an electric current is maintained by an increase of velocity in the inverse ratio of the reduction of cross-section in the conductor, in a manner analogous to that in which constancy of quantity is maintained in a fluid current by an increase of velocity in the inverse ratio of reduction in size of pipe, the same quantity passing through the smaller pipe in the same time as through the larger, by an increase of velocity; but since the velocity of an electric current has never been estimated, except by the remotest approximation, the analogy fails as in the former instance. But if we regard varied quantity and intensity of molecular vibration, produced by a variation in the amplitude or the length of the waves, by which electric energy is supposed to be transmitted, as the true explanation, our conceptions of these phenomena become much clearer.

Electric Units.—In order to render possible the calculations required in the various departments of electric work, and especially in electric engineering, it becomes necessary to have certain units of measurement especially adapted to the peculiar electric conditions found in electromotive force, resistance and current. It is also necessary that these units should be established by some authoritative source, universally recognized and acknowledged. The International Electric congress, composed of leading electricians of various nationalities, which met at Paris in 1881 and 1884, was such a body, and the electric units it adopted after careful deliberation have been accepted as authoritative. Most of these units were previously in use, and the work of the congress consisted chiefly in giving them definite value, referable to fixed standards, and eliminating various errors.

The work accomplished by electric energy furnishes the means for absolute measurement, and the C.G.S. mechanical unit is taken as the basis for the electric unit. The initial letters, C. G. S., are the symbols of the three factors, — space, mass, and time; C. standing for centimeter, G. for gramme, and S. for second. Hence the C. G .S. unit represents the work accomplished by the movement of a mass equal to one gramme through a space equal to one centimeter in one second.

Underground Wires in Chicago.

To the Editor of Western Electrician:

Chicago, Nov. 29.—Under the head of "Underground wires in America," the *London Electrician*, of October 28th, comments somewhat severely on the paper read at the recent telephone convention, entitled, "Chicago underground and ærial cables." The editor does not master our methods; can not understand the language employed in describing certain work; is generally very badly confused by the statements made; and declares that he can only venture any opinion at all, with extreme reserve. Then the opinion is advanced, without the slightest reserve, that the workmen in Chicago are ignorant of the elementary principles of laying subterranean wires, and that the results of their blundering please us. He makes the broad and unwarranted statement that "the joints leak and half a pint of water can be poured out of some of the 'sleeves,' but the speaking seems to be rather the better for those eccentricities," and winds up with the expression of the belief that we have a fancy for badly manufactured cables, which we will have no difficulty in gratifying. The editorial throughout, covering not only the Chicago work, but the work done in Brooklyn, New York and Boston, reads as though inspired by a determination to misunderstand and belittle our efforts; picks flaws in the American achievements in the direction of underground cables; and shows us up in a bad way generally. Such a general denunciation of the Chicago work, as is given in the paper referred to, is quite unjustifiable.

The underground work in Chicago, so far as construction is concerned, is well done, and will last a reasonable number of years. It was done by men who were entirely competent, and it is doing as much as was expected of it in every way. Chicago was one of the first of the American cities to put any large number of wires underground, and in 1885 put down about ten miles of cable, containing 1,300 miles of single conductor. The joints in these cables are about 500 feet apart, making for the entire cable mileage about 100 joints. Two years after the completion of the work, *one* of these joints showed a defect, moisture having reached the wires through a blow hole in the solder at the point where the lead pipes joined. It is perfectly plain that the effect of the moisture was to ground the wires, and that with half a pint of water in the pipe at this point the wires could not be used.

The recital of this one case of trouble, coupled with a statement made further on in the paper that we get better results in every way in talking through 4.4 miles of cable—nine pieces—on a wet day than on a dry day, is made the foundation for the sweeping charge that our joints leak, but we are glad of it, and it helps the talking. The statement that talking over the 4.4 miles of cable on a dry, warm day was attended with great effort and much discomfort, is commented upon in such a way as to apply to all cables, short and long, when it is perfectly evident to any fair-minded person that the working of these particular cables, constituting the greatest length of cable mileage that we could get together, was alone alluded to. The generally approved statement that an insulation of 300 to 500 megohms in a cable causes more "cross-talk" or induction, or interference from one wire to another, than an insulation of one megohm, is sneeringly alluded to, but we can not alter the facts on this account. As a matter of fact the entire editorial is a sneer. It intimates very clearly that all that has been done so far has been ill-advised, hasty, temporary, and only of consequence to the extent that it may prove a warning to others. The only advice it has to offer is that we build "some form of tunnel, large enough to admit of all wires and cables being hung in such a way as

to be accessible at all points." A very pretty idea, and *quite new*, even if there are a few trifling objections against the plan, such as the enormous cost; public clamor against tearing up the streets; the lack of room for anything like a tunnel in the streets in the heart of a large city; and the problem—of no mean importance—of determining the size of tunnel, so that it will suffice for the wants of even the near future.

I regret the carping spirit that is manifest throughout the writing, which, however, may in kindness be attributed to a lack of information concerning the real condition of the work done, and the influences abounding at that particular time. B. E. SUNNY.

A Government Telegraph.

Boston, Mass., *Globe:*—If there must be a monopoly, let it be a people's monopoly, controlled by the elected representatives of the people.

Scranton, Pa., *Republican:*—Telegraph lines, owned and controlled by the United States government, cannot be absorbed nor crushed out by the Western Union company.

Kansas City, Mo., *Times:*—A government telegraph is not by any means an absurdity or an impossibility. It will be required because we can find no other escape from a huge burden.

Lexington, Ky., *Press:*—The people demand competition, and the only way by which it can be secured is by a postal telegraph, owned and controlled by the general government.

Pittsburg, Pa., *Commercial Gazette:*—It is wonderful what a strong hold the proposition for the establishment of a government telegraph system has taken upon the public mind. The mass of the people are ready to welcome the change.

Omaha, Neb., *Republican:*—The government owes it to the business of this country to give it cheaper telegraphy. It is certain that this question will be taken up by congress at its coming session, and if that body honestly represents the people something will come out of it this time.

Washington, D. C., *Star:*—When the postal department undertook the carriage of merchandise parcels it didn't buy out the express companies whose business it shared. Neither need it buy out existing telegraph lines when it inaugurates a postal telegraph service in obedience to the popular will.

Minneapolis, Minn., *Journal:*—Let the people of the United States have a telegraph company of their own, one that can not be bought out or crushed, and one that will give the same efficient and courteous service that we uniformly get from the post-office department. The demand for a government telegraph is getting so strong that the politicians will have to heed it.

Petersburg, Va., *Index-Appeal:*—The people are vitally interested in this matter, and we fully expect to see the question of a government telegraph brought to the front during the life of the fiftieth congress. Its consummation will be resisted, of course, by the Western Union monopoly with all the resources at its command, but that is the more reason why it should become a reality.

Richmond, Va., *Dispatch:*—It will send messages from the Atlantic to the Pacific for a cent a word and yet it will "pay". All the people will patronize it. And the man who is now opposing its establishment will then be derided as an "old fogy", and as not one more whit entitled to be called a statesman than the man who would transfer the post-office department to private persons.

Wheeling, Va., *Register:*—A government system and the Western Union working side by side, however, would give to every man sending a message his choice to use the Western Union or the postal telegraph. It would insure promptness, accuracy, reasonable charges and faithful service. It would enable newspapers to get news, election and commercial reports cheaply and correctly, and these advantages are worth tryiug for.

Chicago, Ill., *Journal:*—Doubtless if the art of telegraphy had been in anything near its present state of development when the government mails were provided for, a postal telegraph would have been embodied in the system. As it is, the matter has been delayed much too long, to the great expense and inconvenience of the people, and the remedy should be promptly applied by the forthcoming congress.

Cleveland, O., *Plaindealer:*—It has been objected to the scheme of a government telegraph that it is in the direction of centralization, and therefore not in accord with democratic principles of government. The objection is not of weight. It is no more open to the objection of centralization than is the monopoly by the government of the business of carrying the mails. If one is undemocratic so also is the other.

Chicago, Ill., *Tribune:*—The bugaboo as to a dangerous increase in the patronage of the federal government if a postal telegraph system were established need alarm no one. It would only be necessary to add some 12,000 or 15,000 telegraph operators to the postal service. Experts would be needed for such service and partisan bummers and strikers could not be rewarded by putting them in charge of a telegraph instrument.

New London, Conn., *Telegraph:*—At present the Western Union Telegraph company is hostile to the government and every official message that goes over the wires is at the mercy of Mr Gould. A financial crisis or a diplomatic secret can be manufactured or suppressed by one man! Is this democratic? Is such a state of things consonant with a government by the people, of the people and for the people? Assuredly not—and the Gould monopoly must go.

St. Paul, Minn., *Globe:*—Throughout the entire country there seems to be a demand that the government shall take decided steps to establish a telegraph system of its own, and congress will be urged to legislate on the subject at its approaching session. A combination of the postal and telegraph systems of the country could not but result advantageously to the people, and there would be no danger of an increase of rates in the interest of a few stockholders. By all means let us have a government telegraph system as speedily as possible.

Washington, D. C. *Critic:*—To make assurance doubly sure that the public will not be bled by exorbitant rates for the purpose of declaring big dividends and piling up a big surplus; to reduce the telegraph service to the minimum of cost and the maximum of efficiency, let congress take up this urgent question early in the coming session and enact the necessary legislation for the establishment and maintenance of telegraphic service throughout the United States, under the direct supervision of the government at Washington.

Philadelphia, Pa., *Record:*—"The feudal barons of the Rhine", said the Hon. Josiah Quincy, long ago, "the transportation managers during the dark ages, compelled all that passed to pay tribute, but they lacked the master stroke of financiering in neglecting to compel the people to pay interest forever on the very sums of which they had been plundered." This "master stroke" has been fully exemplified in the operations of telegraph monopoly in the United States, and some relief from its effects must be found by the representatives of the people.

New York, N. Y., *World:*—Senator Edmunds announces that he will reintroduce and press his bill for the establishment of a government telegraph. The bill does not provide for the purchase or leasing of any existing lines. It contemplates the construction of an independent line between the larger cities, and the extension of the system gradually over the country. Senator Edmunds believes that a postal telegraph has come to be a necessity, and that it is as legitimate a government institution as is the post-office. The practical absorption of all telegraphic facilities in the hands of one man, and that man Jay Gould, has done much to strengthen this view, even among those who have heretofore questioned the expediency of such a move. The people do not relish having their means of telegraphic communication under the control of any one man or corporation. It would not be surprising if such a bill as that of Senator Edmunds should pass at the coming session. But one iron-clad condition should be incorporated in it. The telegraph operators employed by the government should be appointed under the civil service law, and should be secure against removal for partisan reason. It would be monstrous to have a government telegraph made part of a spoils machine.

New York, N. Y., *Herald:*—The whole press of the country is vitally interested in the establishment of an independent government telegraph line, because such a line will give the newspapers cheap, accurate and prompt election and news reports of all kinds. The press has only to speak out and congress will order the work done. What is needed is a line coextensive with the area over which the mails are carried, a telegraph office at every post office in the land and a uniform rate.

The Telegraph in Mexico.

Like the land of Grecian fable, Mexico is a paradise girt with fire, says Frederic R. Guernsey in the Boston *Herald*. There are at least three distinct climates—that of the Tierra Fra, or Cold Land, up in the mountains; that of the Tierra Templada, Temperate Land, on the plateau, and extending down the slope toward the coast a few score miles, and, lastly, that of the Tierra Caliente, or Hot Land, which takes in the coast on the Pacific and Atlantic sides with also some of the sloping country.

The Tierra Templada is at the north of the country, characterized by the vast treeless plains, over which must be hauled by railway, or by cart where the railway does not penetrate, the poles and wire for the lines. Oftentimes great loads of poles, cut in the forests around Toluca or Paizcuaro, in the southern part of the republic, have to be slowly and laboriously hauled over the hot plains of Chihuahua and put in place by men who carry their rations for days with them. The cost of the poles and the wire is necessarily greatly enhanced by the transportation, and it may be said that telegraph wire, placed almost anywhere in Mexico, costs the government three times what it did landed at Vera Cruz or Paso del Norte.

Travelers on horseback in northern Mexico traversing these vast, treeless and melancholy plains stop at night for camp, and, finding the telegraph poles accessible and admirably seasoned, cut them down for firewood. And this is not all. The humble ranchero, desiring a stock of wire with which to fence in an enclosure, goes with his peon servants and cuts down a mile or two for use, leaving poles oftentimes prostrate. I have myself seen poles wireless, and also long stretches of wire without poles.

And the poles brought so far at so great an expense have other enemies besides man. There is the insignificant looking worm, the "jengen," which insidiously honey-combs the poles till some fine day they fall at the breath of a breeze, strewing fragments of wood over the ground. This is a formidable opponent of telegraph communication in Mexico, and any bright American who can show how to keep it out of the poles may fairly demand a reward from the Mexican government.

"Y los pajaros son enemigos tambien" (and the birds are also enemies). There is a Mexican woodpecker who sits up toward the top of the poles and pecks and pecks for whole days, till the top comes off, and wires and cross arms go too. A great rogue is this Mexican woodpecker, the sworn enemy of telegraph poles. The linemen (celadores) shoot him when they can, but of what use? One dies and forty come after to the funeral!

And then the white ants, those industrious, unseen hollowers out of timber. These tiny creatures will eat out the inside of a pole till it is a mere shell, solid apparently, sturdy seemingly, but absolutely as good for nothing as an eggshell. Up comes the wind, and the poles blow away as if they were hornets' nests detached by a cyclone. These "hormigas blancas" dig out the inside of house timbers in some parts of the country. They have even been known to so hollow out the legs of a dining table that one day down it came with all its crockery and the noonday meal, too. The hormiga blanca is also the sworn enemy of civilization and progress as represented by the telegraph.

But the Hot Land has its enemies of telegraph also. How Mayne Reid or Ballantyne or Verne would have seized on the facts here presented. Picture to yourselves, good friends on seaside piazzas or lounging on mountain tops this summer day, a country of impenetrable vegetation, with gigantic palms and plantains, with jungles so dense that it is hard work with a stout and

sharp machete to make a path through them, a country of intense heat, of innumerable musquitoes, and ticks, and malaria, and snakes, and vegetation that grows up in a day to a height that interferes with the labor of man.

Such are some parts of the Mexican states of Tabasco and Yucatan, and it is through such regions that the telegraph which connects the Mexican capital with important points like San Juan Baptista or San Cristobal must penetrate. This is country where the linemen go in couples, and armed with rifles to fight off the fierce "puma," or Mexican tiger (tigre), who assaults man and is especially ravenous for telegraph constructors! The Mexican linemen down in the hot coast country shoot many a puma while out attending their lines.

A scarcely less formidable antagonist is found in the monkey tribe which inhabits the jungles and chaparral of Tabasco. Literally "the woods are full of them." Their favorite diversion, when not in quest of food, is to betake themselves to the telegraph line for gymnastic exercises, and linemen assert that often 100 able bodied monkeys may be seen swinging on the wire, festooned, monkey fashion, by looping their tails. The continuous vibration of these forest gymnasts starts the iron nails used on the cross arms, and these often come down, bringing the wire with them.

And it is not a safe matter to undertake to disperse these robust monkeys who play the dickens with the telegraph lines in the sparsely inhabited state of Tabasco. Linemen have found that on shooting a monkey swinging on the wire they have been pursued by a whole regiment of monkeys. "It is no joke (*no es broma*)," said a lineman recently, "to have a tribe of monkeys pursue one; they are very strong (*muy fuertes*) and can hit with a stone or a stick in a fashion to make a man howl with pain, a thing the monkeys enjoy hugely."

In the coast country, especially on the gulf of Mexico side, the wires, from the humid condition of the air, oxidize rapidly, and a wire is found by experience to be in need of replacement in a year's time. This adds heavily to the cost of keeping up the service.

Still another difficulty in maintaining a good service in the Hot Land states is the impossibility of acclimating, in many regions, telegraph operators from the colder table lands. They easily fall a prey to fevers, and, if they escape with their lives, they have been absent from their posts and the service has suffered. So it has been found necessary to make use of natives of those regions, often imperfectly educated, and from whom much must be borne, perforce, for they make blunders with fatal facility and try the patience of the City of Mexico officials to a degree.

New York Electric Club.

The age of electricity will begin in this city about the middle of this month, says the New York *Herald*, paying its compliments to the Electric club of that city. Now, there may be a few over accurate people who will say something about this particular age having begun several years ago—when Ben Franklin tacked the tail to his kite, or, perhaps later, when Morse hung up his first telegraph wire in his back yard, or later still, when Edison began to worry the patent office. They are all, however, in error, and, as was said before, the age of electricity, so far as the every day life of New Yorkers is concerned, will begin according to the above announcement.

The place where it will begin is the old Townsend mansion, number 17 East Twenty-second street, which, in about a month, will be opened as the club house of the new Electric club. For many weeks past a score of expert electricians have been toiling in the building, and when they finish the doings in that house will be marvelous enough to make Aladdin in his tomb near Bagdad grit the stumps of his teeth with envy.

The Electric club of New York was organized less than a year ago by about thirty of the leading electricians of the city. It has grown so rapidly that its modest suite of rooms at the Union Square hotel has become totally inadequate to accommodate the 325 active members it now numbers. The Townsend mansion was accordingly secured last month on a long lease and extensive alterations were at once begun.

The officers of the club are: Henry C. Davis, president; G. W. Hebard, J. B. Powell and W. L. Strong, vice presidents; C. W. Price, secretary, and Andrew J. Dean, treasurer.

The new club house will be fitted up on the basic principle that electricity is a force that has heretofore been undervalued by the world at large. It is generally regarded merely as a force that enables telegraph and telephone and street lighting companies to water their stock.

The Electric club will practically demonstrate, at their new club house, that electricity can be made to serve a man at almost any moment of his life with the fidelity of a $1.50 pug dog and an accuracy of a $2.50 watch.

Imagine yourself, some evening next month, a guest of the club at the new club house. The front door opens before you without a touch. In the spacious hall you are met by a smiling attendant who leads you into the reception room and helps you to take off your coat. You offer him a quarter as a testimonial of your regard for his services, and he instinctively puts out his hand. The next instant, however, the hand falls nerveless to his side, and, with a hollow smile, he declines your "tip."

This phenomenon you will observe again as you go through the club house. It is the work of the "lightning tip eradicator," introduced by a member of the club. By long study he has discovered the exact motions made by a waiter in the act of receiving a tip and has devised an undergarment, provided with electric wires and buttons which connect with an electric belt. When the waiter, from force of habit, extends his hand to receive a tip, the muscles thus set in play press the electric buttons and the electric belt at once gives the waiter a violent shock in the pit of the stomach. This rarely fails to remind him of the true dignity of his calling.

You now tell the attendant that you wish to see your friend, a member of the club, who had invited you to visit him that evening. The attendant presses one of his vest buttons several times, and you feel as many faint but distinct taps on the soles of your feet. A second afterward you feel an answering series of taps. "Mr. ———, sir, says for you to come right up to the billiard room, sir, on the third floor," announces the attendant as he leads the way to the automatic elevator. The whole matter is very simple. The attendant is provided with a "condensed vest pocket battery." The human body being an excellent conductor of electricity, and the metal floors of the building being highly charged with the fluid, the attendant has simply telegraphed your arrival to your friend, who, in common with the other inmates of the house, receives the message through the soles of his feet wherever he may be in the building. He answers the message with his own vest pocket battery, and the next minute you find yourself in the billiard room. Your friend expresses his profound joy at your arrival by ordering some soda water, and he does it with his vest pocket battery while he is waiting for his antagonist to play, and without recourse to the old fashioned and cumbersome system of speaking tubes or electric buttons in the wall. "Of course," says your friend, "these constant taps on the soles of your feet feel rather odd at first, but as every one connected with the club, members and servants, has a particular number, you soon learn to pay no attention to any call that is not intended for yourself. Besides, it is well known that mild shocks of electricity are good for lumbago and no end of other muscular ailments." Keeping this encouraging thought in mind you soon become accustomed to the new system of pedal telegraphy and after a time, to all the other marvels produced by the aid of electricity throughout the club house.

One of the principal of these novel devices you find in the lecture room, where addresses are to be given once every week by prominent electricians. The chairs on which the audience sit are fitted up with seats of sensitized rubber like the diaphragm of a telephone. By the aid of dials on the wall, communicating with each seat, the lecturer is at once enabled to gauge the effect produced on each hearer by any startling discovery he may announce, for the faintest increase or variation in the muscular or mental action of the hearer is at once communicated by way of the sensitized chair bottoms to the dials. This saves the carpet from the wear and tear it would otherwise receive if everybody stamped both feet in order to applaud. These sensitized chair bottoms, by the way, will doubtless find much favor with every young woman who wants to correctly size up the intensity of the emotions in the heart of her suitor when he asks her to marry him.

Among the minor devices that will make life pleasant at the new club house will be contrivances for getting a man out of bed, giving him a shower bath and buttoning his collar at the back of the neck. His shoes will be blackened, his clothes brushed, his morning paper cut and all dunning letters sorted out from his morning mail and dumped in the ash barrel by electricity. In short, when our Electric club moves into its new club house, electricity will be successfully used to iron out every wrinkle in the path of each member as soon as he promptly pays his dues to the club treasurer.

CORRESPONDENCE.

New York Notes.

New York, Nov. 26.—It has been finally decided that the subway contractors must suspend their work at the end of the present month, as General Newton, commissioner of public works, has refused to rescind his order that no permits shall be issued for the tearing up of the streets on and after Dec. 1st This important work in the streets of New York has been well started, the season closing with about ten miles of conduit completed and some hundreds of poles removed. It is expected that it will take about three years to complete the entire underground system, and that the cost will be in the neighborhood of six to seven millions of dollars.

The East River Electric Light company, using the Thomson-Houston system, has leased for ninety-nine years the property on the block bounded by East Twenty-fourth and Twenty-fifth streets and First avenue and the East river, and will use the seven-story building now on the premises for its electric light plant. For its west side station the company has also leased for thirty years a building at the foot of West Eleventh street.

The Edison Illuminating company are extending their central station lighting and expect by spring to cover ten times as much territory as at present. Heretofore they have limited their operations to the lower part of the city, but stations are now under way in Twenty-sixth street, near Broadway, and in Thirty-ninth street, near Sixth avenue, and land has been bought for another station on Fifty-fifth street, near Sixth avenue. The work of installation is being done in the most thorough manner. The Twenty-sixth street station, which may be taken as a type of the others, is upon a plat of ground 50 feet wide by 100 feet deep, and is to be four stories high. The workmen are now putting in the second tier of beams. The arrangement of the building provides for coal bunkers upon the top floor, boilers upon the second and third floors, and engines and dynamos in the basement, so as to get as firm a foundation as possible. This arrangement is that which has been found to be successful in the boiler-house of the Steam-heating company in Greenwich street. The arrangement of coal bunkers upon the top floor enables the firemen to feed the furnaces with half the work usually necessary. The coal falls by chutes almost into the furnace of its own weight, and the ashes may be dumped at once into the chutes, which carry them to the ground. The new building is to be fireproof throughout, and the dynamos are to be of the most perfect type known. By the most modern devices for making steam without much noise or smoke, it is expected that the building will be quiet and its operation unobjectionable to the most fastidious neighbor. The Thirty-ninth street station is about as far advanced. Mr. Beggs, the superintendent of the company, expects to supply light to those neighborhoods before the end of spring. Each of the up-town stations will have a dynamo capacity for 30,000 incandescent lights, more than double the capacity of the Pearl street station. As it is the rule to put in lamps or to wire dwelling-houses for twice the number of lamps which the generating station could light

up at one time, more than 60,000 lamps will be put into the houses within one mile of each station. Down-town it often happens that almost all the 15,000 lamps supplied by the Pearl street station are used at one time. On a dark day, between the hours of three and six, the station has all that it can do to supply the demand. Also down-town there is a considerable demand for power, which may not be so extensive in the dwelling-house districts, although it is quite probable that small electric motors will be largely used for pumping water and running sewing machines in private houses. The Pearl street station supplies 300 horse power a day used in motors from 1-4 horse power up to 10 horse power. A great many elevators are now run by electric motors and a large variety of shops use them for lathes and small machinery. The laying of the wires through the streets of the districts to be supplied up town has been going on for about a year, the workmen often going at the rate of a mile a day. By the time that the stations are ready to start up the whole district will be covered with a network which will reach every house in it. From the Twenty-sixth station most of the up-town theaters and hotels can be supplied with electric light, without the trouble of running their own engines and dynamos. As to the cost of the light, it is still somewhat greater than that of gas, but its superiority is such that the Edison company do not even offer to put in the wiring in private houses at their own expense as they did down-town; each house-owner has to bear that expense himself if he wants the light. From the up-town stations in Fifty-fifth street houses as far up as Sixtieth street can be supplied. The aim is to make one station supply light to about a square mile of territory. When the three stations are finished, the whole district between Twenty-third street and Sixtieth, Third and Eighth avenues will be ready for electricity.

The Direct United States Cable company have opened an office at 444 Broome street, in the dry goods district. The wires in this office will connect directly with the main cables.

Theodore B. Starr has in his show window on Broadway a watch movement ticking regularly under most trying circumstances. It is surrounded by large horseshoe magnets, which seem to have no influence upon it, while an ordinary watch movement would be worthless until demagnetized. It is a most effective advertisement for the Geneva Non-Magnetic Watch company.

The Automatic Fire Alarm Signal & Fire Alarm Extinguisher company, who operate under the Watkins patents and who have been doing a large business in New York for several years, are about to extend their system to Philadelphia. They now have an improved outfit on exhibition at 294 Broadway, and are calling particular attention to a new and simple form of transmitter.

The Callender Insulating & Waterproofing company have found the demand so great for their Trinidad electric light line wire that they have been obliged to double their manufacturing facilities.

Another insulating compound that is giving general satisfaction is called "Balata" and is manufactured by the Bishop Gutta-Percha company. This is designed especially for flexible cords, and is water and acid proof, besides having all the insulating qualities of gutta-percha, while it will not become hard or brittle in any location.

The electric railroad between East New York and Jamaica is nearly completed and it is expected that in the course of a week or ten days it will be in practical operation. Six miles of road will be in operation, and the Van Depoele system will be used. A.

Detroit's Budget.

DETROIT, Nov. 26.—The Grosse Pointe Electric Railway company has a novel law suit on hand. Gilbert M. Moran, contractor, says he entered into a contract to build the road as far as Clark avenue—six miles—for $7,350, and was to receive in addition $8 per mile for preparing and laying the timbers in construction. The officers of the company say that Moran agreed to build the six miles of road for $7,350, making the cost about $3.85 per rod. When it was decided to extend the road, the contractor was asked if he would build another mile at the same rate. He agreed to do so, and the engineer drew up a contract, but by mistake put the decimal point in the wrong place, making the price $38.50 instead of $3.85. The error was not discovered until after the contract had been executed and the road built and accepted. The claim involves $14,024.50, a larger sum than was charged for building the first six miles.

The public lighting plant committee, of the Detroit city council, has been informed by the city counselor that there is no provision in the charter empowering the city to go into the lighting business. Nevertheless, the committee propose to proceed with the investigation as to the practicability of the city owning its own plant, and has appointed a secretary and is now looking around for an electrician. C.

From the Pacific Slope.

SAN FRANCISCO, Nov. 20.—The *Examiner* devotes a page, with drawings, in support of a projected cable which shall cross the Pacific ocean and connect the United States directly with China, Japan, Australia, and the Sandwich Islands. This project has been agitated from time to time, but the magnitude of the undertaking has debarred capitalists from making the venture. Appeals to the several governments have been frequently made, and as far back as 1873 congress passed an appropriation bill providing for the survey of the Pacific ocean's bed, between this coast and Japan, with a view of ascertaining the most feasible course over which to lay a cable. The work was performed by the Tuscarora, under command of Commodore Belknap. Subsequently, Commander J. N. Miller continued the exploration from the Sandwich Islands to Brisbane in Australia. With the exception, perhaps, of the Kuro Siwo, or black stream, of Japan, where the water was nearly six miles in depth, and the current of terrific strength, no insuperable difficulties were discovered. If the government at that time entertained any idea of laying a cable to Japan, it was abandoned, and since then nothing more has been done by congress in this direction, though appeals to it have been frequent. Residents of the Sandwich Islands have been the most persistent and indefatigable agitators in behalf of a cable, and Cyrus W. Field has been regarded as a sort of commissioner intrusted by the islands to press the matter upon the attention of congressmen, and in every other manner do all in his power to connect the islands with some port on the Pacific coast by cable. Thus far so little has been accomplished in this direction that many have reached the conclusion that Mr. Field has not been very sincere in his advocacy of the project. The importance of thus connecting those islands is given in a quantity of interviews with business men and citizens of California. Due emphasis is laid upon the strategic position of the islands in the event of war between the United States and any foreign power.

It is shown that the laying of a telegraphic cable to the Sandwich Islands is a desirable undertaking from every point of view it is possible to regard it. San Francisco merchants, shippers, consignees, and the thousands generally, whose interests are more less closely linked with the maritime commerce of the city, would find it to their advantage, especially if the line were continued to Australia and Japan. The profile of the bottom of the Pacific, as shown by the drawings to the United States survey, demonstrates that the cable can be laid without difficulty.

It is suggested that two branch cables be laid from the California coast, one starting from San Franscisco and the other from San Diego, and coming together at a cable station on the Sandwich Islands. From the Sandwich Islands two main stems should be laid, one to proceed south through the Phœnix, Samoa, and Fiji islands to Brisbane, Australia, and the other to run directly across the Pacific to the Bonin Islands and then north to Yokohama, Japan. From Japan a supplementary cable would connect the main oceanic system with China. Still another set of soundings are given as an outline for a cable from the United States to Japan. This projected cable would run northwest from Cape Flattery, or some point near Puget sound, to the Aleutian islands, where cable stations would be established. From the most westerly of the Aleutian islands the cable would run south-southwest to Yokohama, Japan.

From the reports of the naval officers who made the soundings, it appears that the Pacific bottom is very uneven. The currents in some places are too swift to admit of laying a cable, but by avoiding these localities still water was found. The deepest sounding was found to be 27,860 feet, but from San Francisco to Honolulu the ocean bottom is regular, and readily adaptable to the laying of a cable.

The *Examiner* lays the facts and possibilities before the business men, and shows that the growing trade with China and Japan, with the Hawaiian islands, and the various groups in the southern Pacific and Australia, warrants the expenditure necessary for a fully-equipped cable system. It shows that little is to be hoped for from government appropriations, and urges the laying of Pacific cables by private enterprise and western capitalists. C.

Little Rock, Ark.

LITTLE ROCK, Ark.—The people of Arkansas are now breathing a mixture of dust and smoke it would be libel to call air. There has been no rain for months and everything is dry as powder. Streams and swamps that were never dry in the recollection of the famed "oldest inhabitant," or even the "Arkansaw Traveler" himself, have dried up and disappeared. There are fires in the woods in all directions and an immense area of forest has been burned over and destroyed, as well as farms, houses, barns, fences, and products. Telegraph and telephone wires have suffered all over the state and all business is taken subject to delay. Little Rock has had several fires and suffered a loss of over $300,000 within the last week. The fire department has been called out from three to six or seven times every day, and as they depend entirely upon the telephone exchange for fire alarm service the operators have been kept busy.

The suit of the Bell Telephone company against the Southern Telephone company here, has been postponed until next month. The Southern company are busy preparing their case while several parties who have been selling infringing telephones throughout the southwest, are waiting to see how the case goes. Every one is anxious to hear from the supreme court cases.

Parties are trying to organize an incandescent light company here and report good success, having secured subscriptions for about a thousand lights and $25,000 stock. There are several isolated incandescent plants here but no central station.

The Gazette Printing company has a Brush plant of about 100 lights and the two cotton seed oil mills of the Little Rock Oil & Compress company have Brush plants of 150 lights each, while the Southern Cotton Oil company run 150 lights and use the Westinghouse system

The Gas company has control of the arc business and is just completing a splendid new station with a capacity of 200 lights of the Brush system. The building is a two-story brick upon a solid slate foundation Adjoining it is a side-track for coal cars while the ashes and waste are dumped directly from the engine room into the river. They are placing a new 150 horse power Lane & Bodley Corliss engine with a 200 horse power Heine boiler and have plenty of room for two more of same size. They also expect to furnish incandescent lights it desired and, if there is any money in electric lights, they ought to get some of it. M.

THE ELECTRIC LIGHT.

The great opera house at Vienna had to be closed recently because of a break-down in the electric light apparatus, caused by the cracking of the plates in the boilers, which were of Austrian manufacture. A complete new plant of boilers, amounting to 750 horse power, has been ordered of the Glasgow house of the Babcock & Wilcox company, and it is expected that they will be ready for service in two weeks from the date of the order, which, if accomplished, will be remarkably quick work.

The method of telegraphing at night, tested by the military authorities of Belgium, noted last week, and the same method that is used in En-

gland, is described more in detail in the following. The apparatus is a combination of the electric and optic telegraph. The optic station is made up of a balloon held at any height above ground. Inside of the boat floated by the balloon, or on the bottom of the boat, six electric lamps were attached, which were connected with an electric battery on the ground by means of wires running along the rope which held the balloon captive. On the ground there was a Morse telegraphic apparatus. An experienced operator spelled a message, the characters of which are registered on a common Morse apparatus by shorter and longer strokes upon a running band of paper. The shorter or longer the line is on paper the shorter or longer is the time corresponding to it during which the electric current is working. Instead of marking time on paper, the apparatus used at the experiments made at Antwerp keeps the six lamps attached to the balloon blazing in bright light. Any man understanding the Morse alphabet is able to read the characters given by the successive flashes of light of the electric lamps. A number of messages were thus spelled and correctly read by posts at distances of several miles. The balloon was only some 300 feet above ground. The higher it is allowed to ascend the greater is the distance at which its characters can be seen and understood.

A press despatch of the 25th ult., states that the stockholders of the Westinghouse Electric company have ratified the recent deal with the Consolidated Electric Light company of New York.

THE TELEPHONE.

A project of long standing concerning the management of telephone exchanges by the state has at last been carried out, says the Vienna correspondent of *Industries*. The government offer to connect subscribers to central telephone exchanges in various towns and with the telegraph offices, in order to facilitate telephonic business, and also the transmission and receipt of telegrams by telephone. The charges are moderate, and in the majority of cases will not exceed 100 florins (£8. 10s.) per annum. This change in the administration of telephones has been received very favorably by the present subscribers to the private telephone exchanges, who are all anxious to be connected with the state exchanges. As a consequence there has been a drop in the value of the shares of the private telephone companies.

John Buckley, of Meriden, Conn., caught a snapping turtle and took it to the telephone office where he works. He thought that he would kill the animal by electricity, and so put the end of a wire in front of it, and the turtle snapped it and held on. Then Buckley put another wire under the shell and turned on the entire electric current of the office. The turtle shut his jaws tighter and closed his shell, and in five minutes was apparently as dead as Julius Cæsar, but the next morning he was walking around the office quite heartily. It had received an electric shock powerful enough to kill a man.

W. B. Joyce, manager of the telephone exchange in Fargo, has been promoted to the position of manager of the exchange in Minneapolis, and began his duties there Dec. 3d. He was succeeded by S. C. Scoville, who went to Fargo from Stillwater, but who was formerly from Hartford, Conn. The Fargo exchange has about two hundred and fifty instruments now in operation.

Mayor Babcock, of Cleveland, Ohio, recently wrote to Washington, asking whether or not the government would pay for telephone service at the Cleveland life saving station. There is a telephone in service at the station, but it is paid for by vessel men and citizens who appreciate its value, but the rental will expire at the close of the season. The mayor received an encouraging answer from General-superintendent Kimball, of the life saving service, inquiring for particulars and the cost. The value of the telephone in the life saving service was thoroughly established by the prompt aid which it brought to the wreck of the schooner Zach Chandler, near Cleveland, and the recent wreck of a vessel near Chicago.

Wahpeton, D. T., has 68 Cushman telephones in use; Superior, Wis., 48; Oscoda, Mich., 37; Findlay, O., 100; La Porte, Ind., 50; Elkhart, Ind., 75, and South Bend, Ind., 150. A line is being built from South Haven, Mich., to Lawton, a distance of forty miles.

The Great Southern Telephone & Telegraph company has filed a suit in the civil district court of New Orleans, La., against the Southwestern Brush Electric Light & Power company for an injunction restraining the defendant company from hereafter running any of their wires within a distance of at least four feet from any of petitioner's wires; from attaching or affixing any of their wires to or upon any of petitioner's poles, cross-arms or fixtures; from running any of their wires within a distance of three feet from any of petitioner's poles, and from crossing any of petitioner's wires without necessity, and then only upon proper and additional insulation, and for judgment commanding the Southwestern Brush Electric Light & Power company to remove all of its wires and fixtures from petitioner's poles and property.

In Akron, O., recently, while a snow storm was raging, according to a press dispatch, "a wave of electricity from the air went into the telephone exchange office over the wires, with startling and harmful results. Every drop in the exchange fell, and the four female operators were terribly shocked. They tore the earphones from their heads and fled from the room in a perfect shower of sparks. Two of the operators were quite seriously stunned, and one of the young ladies was completely disabled. All suffered terrible pains in their heads. A perfect gale had been blowing, and the sky wore a very peculiar hue, that attracted every body on the streets. Manager Saylor, of the telephone exchange, says that it was the most peculiar freak of electricity that he had ever experienced and he had never seen anything to approach it save in 1879, in Toledo, when a wave of much smaller proportions swept over that city."

A new telephone company at Buenos Ayres has ordered from the Paris General Telephone society the necessary material for a system comprising 2,000 subscribers, about to be established in that town.

THE ELECTRIC MOTOR.

The Nayaug & Crosstown railway of Scranton, Pa., began laying track last week and will have a Van Depoele outfit running within 30 days.

The Scranton, Pa. Electric Railway company are extending their road and have ordered four more cars, two from the works at Troy and two from Pullman. Each of the cars will be equipped with a 25 horse power Van Depoele motor.

J. K. Cummings in the *Globe Democrat* of St Louis says: I am satisfied that the gentlemen who invested such enormous sums of money in cable railway plants will soon have occasion to regret it. I am as well satisfied as I am that the sun will rise to-morrow that the only logical street street railway motor is that of electricity carried on the cars in storage batteries. I have investigated the matter, and pronounce at least two of the motors now before the public as successful. Just now they are expensive, but the principle is established. One or two years at the most will have brought about the improvements that will make the electric motor the safest, surest and cheapest of motors. Mind you, I mean storage battery motors, for anything is to be preferred to the overhead wire system of which so much is said. I make the prediction that inside of ten years the cable system will have been abandoned, except in instances of very heavy grades, such as obtain in SanFrancisco.

It is said that the Southern California Motor Road company has a scheme for giving the citizens of San Bernardino lots of fun this winter. It will run a road up to the Bear Valley reservoir, which is 6,000 feet above the sea. Ice forms there in the winter, and the road will take up skating parties, which can leave town at 6 in the evening, run up in two hours, have three hours' fun and get back at 1 o'clock the next morning.

A proposal for a thirty-years' privilege for an electric tramway in Petropolis, Brazil, has been referred to the provincial assembly by the president of the province of Rio.

The Jamaica and Brooklyn road, which will use the Van Depoele system, is only waiting for its cars from Pullman. This road has a curious history. It was chartered in 1807 as a toll road and has been maintained as such to the present day. Eminent legal authority has declared that with this aspect of the case, the city of Brooklyn and the subway commission have no right to meddle with it. The Long Island Electric company have been organized with a capital stock of $100,000. They will furnish the power to run the Jamaica and Brooklyn road and for electric lighting purposes. They propose to put up lines in Jamaica, Woodhaven and East New York.

THE TELEGRAPH.

At a meeting of representative grain merchants of Illinois and Indiana at Lafayette, Ind., Nov. 23d, resolutions were adopted, favoring governmental control of the telegraph.

Upon the telegraph line between Bâle and Lucerne M. Hagerbach has recently carried out some experiments to determine the rate of propagation of the current. His method is extremely beautiful and ingenious, and is based upon the well-known experiment of Lissajous, in which a ray of light is reflected successively from the prongs of two tuning forks which vibrate in planes at right angles, says *London Electrician*. If the forks are precisely in tune, then the resultant motion of the reflected ray describes upon the screen either a right line, an ellipse, or a circle according to the relative phase of the vibrations of the two forks. In M. Hagerbach's experiment the vibration of the forks is maintained by an electro-magnet make-and-break in the usual manner. The electro-magnets are placed in circuit with a battery, and a switch is arranged so that the telegraph line can be thrown into circuit between the two magnet coils. The line being first cut out of circuit it is found that the spot of light describes a narrow ellipse, showing that the phase of the second tuning fork is slightly behind that of the first owing to the retardation in the coils of the magnet. But as soon as the whole length of the line is thrown into circuit the ellipse widens out, and thus visibly demonstrates the increase of retardation. From measurements of the figures described the time of retardation can be calculated. M. Hagerbach made the experiments over various lengths of line, but the actual values obtained are not of much value owing to the very complex nature of the problem. The retardation varies directly with the square of the resistance, but it depends also upon the permittance, inductance and impedance of the circuit, and of these terms no record is given. The results showed, however, considerable departure from the simple ratios of the squares of the resistance of different lengths of the line.

The Commercial Cable company, of New York, has increased its capital stock from $4,000,000 to $6,000,000.

At Ti usville, Pa., one day recently, it is said a telegrapher sent 58 words a minute for 46 minutes—an unprecedented feat.

The bicycle has been adopted in Persia. Six of the machines are in use in Teheran—two by nobles, the others by telegraph men.

The annual meeting of the stockholders of the Bankers' and Merchants' Telegraph company, in Ohio, one of the lines at present operated by the Postal Telegraph company, was held at the Forest City house, in Cleveland, on the 9th ult. The only heavy stockholder present was Secretary Dwight Townsend, of New York. President E. S. Stokes and a trust company owning a large block of stock were represented by proxy. The directors elected were Edward S. Stokes and Dwight Townsend, of New York; A. V. Kurtz, J. L. Chamberlain and S. T. Paine, of Cleveland. The directors were sworn into office and then Edward S. Stokes was re-elected president and Dwight Townsend treasurer.

The Western Union office at Chattanooga, Tenn., was damaged by fire on the 6th ult.

A press dispatch of the 28th ult. from Boston, Mass., says: Judge Colt in the United States circuit court to-day filed his decision sustaining

the claim of the commonwealth of Massachusetts against the Western Union Telegraph company for about $10,000 in taxes for the year 1885. The case was originally brought in the state courts by the attorney general, but was transferred to the United States courts by the defendant. On May 1, 1885, the telegraph company owned or controlled 146,052 miles of lines, of which 2,833 miles were in Massachusetts. The tax commissioner estimated the value of the company's stock at $47,500,000 and allowed as credits $8,773,622, leaving a balance of $38,713.924. Of this the commissioner estimated the value in Massachusetts at $750.000, and assessed a tax of $10,618. More than 2,334 milesof the company's lines in Massachusetts were over post roads, and the commissioner ignored that fact. At the same time the telegraph company owned real estate in the state subject to taxation worth $48,000. No deduction was made for this. The position taken by the defendant company was that the tax was illegal—first, because of its operation and effect upon a franchise granted by the United States and used for its purposes and benefits; second, because it is a tax upon interstate or foreign commerce; third because it is in effect levied upon real estate located and taxed in another state. Judge Colt finds first, that there is nothing in the act of congress granting privileges to telegraph companies which impairs the right of a state to tax the property or franchise of a corporation in the manner exercised by the state of Massachusetts. Regarding the second point, the court finds that the Supreme court of the United States has decided that a state statute imposing a specific tax on each message beyond the state was void so far as it was a tax on interstate business. In the present case however, the tax is imposed upon the capital stock of the corporation, and Judge Colt can find no case which sustains the view taken by the defendant. Upon the last point raised, the court finds that there is a question of legislative discretion and no valid ground has been suggested upon which this court for this reason has a right to declare a tax so levied invalid in whole or in part. A decree is accordingly entered for the complainant with an injunction against the Western Union Telegraph company doing business in Massachusetts unless the tax is paid within thirty days. The amount is increaed under the law by 12 per cent. interest from the time when the tax was due.

About 92 per cent. of the toll revenues of the Western Union Telegraph company last year was derived from commercial and family and social messages, and 8 per cent. from the press. The news service delivered by the company's wires during the year—counting one delivery at each place served—foots up some 740.000,000 words, of which 578,000,000 words were for the various press associations and 162,000,000 words were special reports for individual newspapers.

Senator Bland, of Missouri, in speaking of important measures to come before congress at its next session, said to an interviewer: "The question of a government telegraph system will attract considerable attention. The telegraph has become a public necessity as a means of communication. The government could carry on this service for the public at a merely nominal cost, whereas it is now in the hands of one or two men who are making an immense profit by charging exorbitant rates. The people are beginning to realize that something should be done, and a government telegraph system seems to be the only practical solution of the question."

NEW ENTERPRISES.

The Jesuit society of Prairie du Chien, Wis., are about to erect college buildings that will cost about $300,000. Fred Heed, of Dubuque, Ia., is the architect. The plans are not fully completed.

C. T. Hancock, of Dubuque, Ia., will build a residence to cost $20,000, from plans by F. D. Hyde, architect, of the same place. Electric bells and a fire alarm will be put in.

J. S. Reben, of the *Evening News*, Kansas City, Mo., will build a business block of four stories to cost $25,000.

Personal Paragraphs.

The marriage of Abram Lawrence Bogart, of New York, to Miss Julia Appley, of Jamaica, N. Y., was recently recorded. Mr. Bogart is a hale, hearty gentleman of 69 years, who has accumulated a goodly fortune out of electrical inventions, while the bride is a young lady of 19 and a great favorite in Jamaica.

J. G. Kaelber, formerly of Schmidt, Kaelber & Co., of Rochester, N. Y., has been appointed general western agent of the Western Electric company with headquarters at 3 and 4 Duff block, Denver, Col.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	390
Central Union	44	45
Michigan	76	77
Great Southern	30	32
Colorado	18	20
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	28	30
Missouri and Kansas	68	69

Miscellaneous Notes.

A New York dispatch of recent date says: Sergeant Hollingmoff made experiments at Sandy Hook to-day in firing nitro-glycerine from a 100-pound Parrott rifled gun, using eighteen pounds of service powder a shot. The shells weighed about ninety-two pounds and were charged with five pounds of nitro-glycerine each and provided with the inventor's igniter. The gun was fixed in an ordinary cradle, the shots being directed against a fourteen-inch-thick target of wrought iron. The first shell exploded on the target, making a depression about four inches deep and dispiacing the target about three inches. Some fragments of the shell were scattered over the fortress, scaring those inside. The second shell made a crack in the target about fourteen inches long and a quarter of an inch wide, and broke two rivets, one three and a half inches and the other two and a half inches in diameter. The third shell exploded, making an impression about five inches deep. The target was displaced about twelve inches and torn off the wooden base to which it was fastened. Up to this time this target had stood all kinds of shots, even gelatine filled shells. The inventor believes that if he could have had steel instead of iron shells the target would have been blown to fragments.

A carrier pigeon service between the Bahama Islands and Key West, Fla., is to be established in the interests of the United States signal service. It is expected that the service will be of great benefit to shipping, as more accurate and reliable information in regard to storms in the West Indies can be obtained.

A dispatch from St. Louis announces that there is a corner in the spelter market by the French syndicate which has operated through its agents in Missouri, Illinois and Kansas, where about 26,000 tons or three-fourths of the total output of this country are annually produced. The syndicate has conducted its operations so quietly that its object was not suspected until all the stocks of metal were warehoused and all furnaces under contract. The impression prevails that the furnaces are completely sold up for November, December and possibly for January. Prices are higher.

The Albany, N. Y., association Stationary Engineers, at their meeting November 3d, listened to a lecture on "Electricity," by Professor Onderdonk.

Petroleum was known to mankind from the dawn of history. It was spoken of in Sweden in 1750. In western Pennsylania it was found on the ground and used as a medicine many years before wells were bored. In 1858 a well seventy-two feet deep yielded more than one thousand barrels a day. In 1880 the production amounted to 25,000,000 barrels, and the stock on hand June 1st, 1880, was valued at $11,000,000. Russia has valuable deposits in Baku, long known but just put to commercial use. The value of exports thence in 1882 was $15,000,000.

A syndicate is organizing in Germany to put in operation Professor Elihu Thomson's electric welding apparatus.

Business Mention.

The Western Electric company, Chicago, has closed a contract for a forty-light plant at Fort Collins, Neb.

The Boddie block, corner of Jackson and Franklin streets, Chicago, to be occupied by Kuh, Nathan & Fischer, wholesale clothiers, will be lighted by a forty-light plant of the Western Electric company's system.

J. L. Griswold, of St. Louis, in remitting to the Western Electric company, of Chicago, for the fire alarm and guest call put in by that company, writes: "Permit me to say that the system is working with admirable success, and is giving excellent satisfaction. I am much pleased with its introduction into my hotel, and pay this bill with much cheerfulness believing that I am getting full value received for the money."

The Callender Insulating & Waterproofing company, of New York, have received an order from the Thomson-Houston Electric Light company, of the same city, for 250 miles of their Trinidad wire—an insulated and waterproof wire. The order is a large one, and marks a departure of a leading electric light company in substituting an improved form of line wire for that commonly used. The use of a good insulated waterproof wire for electric light circuits means the avoidance of fires, grounds, leaks, and dangers to human lives from accidental shocks occasioned by the use of poorly insulated wire. The Mendota Electric Light company have also adopted the Trinidad wire.

Notwithstanding the high rate of Canadian duties upon American goods and machinery, considerable activity is now manifested throughout Canada in electric light apparatus. The American Electric Manufacturing Co. are shipping considerable quantities of apparatus to the Dominion. A. R. Williams, of Toronto, Ont., has sold a number of plants and has just ordered a 25-light dynamo machine and lamps from the American Co. to use as an exhibit in the coming Provincial exhibition to be held in Toronto next month.

Electrical Patents.

Issued Nov. 22, 1887.

373,435. Galvanic Battery. Horatio J. Brewer, New York, N.Y.

373,452. Insulating Joint or Pipe Coupling. Emil F. Gennert, Brooklyn N.Y.

373,508. Printing Telegraph. Charles J. Wiley, Brooklyn, N.Y.

The printing is done upon one broad band or sheet of paper by means of a series of type-wheels mounted upon a shaft, each type-wheel being used to print its own stock alone.

The quotations appear in columns, side by side, with the name of the stock indicated at the beginning of each column.

The invention is well covered by twenty-seven claims.

373,519. Telephone Apparatus. Isaiah H. Farnham, Malden, Mass.

The invention is designed to avoid or mitigate the troubles resulting from including the high resistance coils of the clearing-out annunciators in the talking circuit. A relay of low resistance, say five ohms, is included directly in the circuit between the spring grips instead of the high resistance coil of a clearing-out annunciator. This relay operates a delicately suspended circuit-closer placed in a local circuit, which local circuit includes a battery and the high resistance coils of the call annunciator. When the relay is energized the local circuit is closed through the call or individual annunciator, which thus is made to indicate the clearing-out signal.

373,584. Dynamo Electric Machine. Thomas A. Edison, Llewellyn Park, N.J

The seventh clause defines the invention as follows: "In a dynamo electric machine the combination, with the field magnet, the armature, and the commutator, of the extra inducing coils and the extra field magnet having adjustable pole pieces."

373,691. Apparatus for Purifying and Separating Fatty Substances by Electricity. Heinrich F. D. Schwahn, Kansas City, Mo.

373,739. Prevention of Sparking in Electric Motors and Generators. Daniel Higham, Philadelphia, Penn.

Coils are placed on opposite sides of the armature alongside the edges of the projecting pole pieces.

373,759. Electric Coupling. Geo. W. Taylor, Leavittsburg, Ohio.

373,761. Electric Arc Lamp. Gustav A. Wiese, San Francisco, Cal.

373,767. Device for Attaching Tablets to Telephones. Howard H. Butler, Canton, Ohio.

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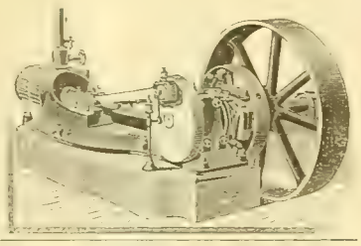

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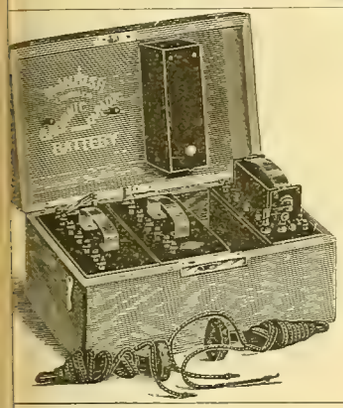

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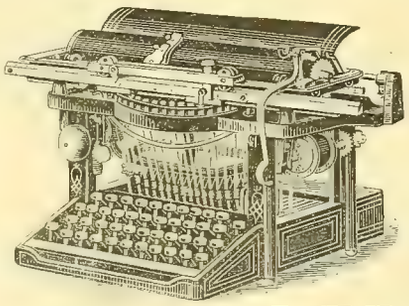

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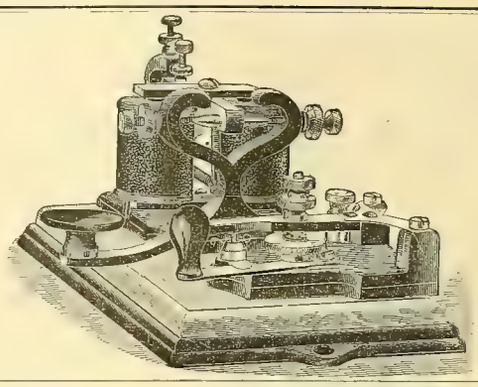

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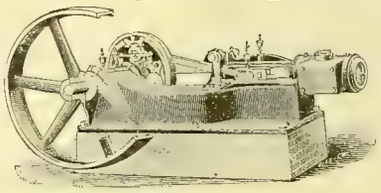

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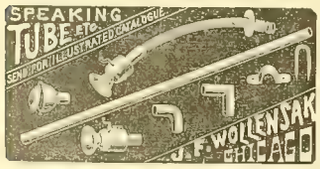

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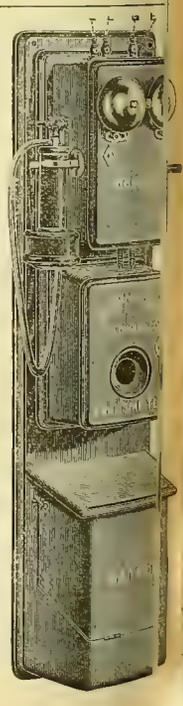

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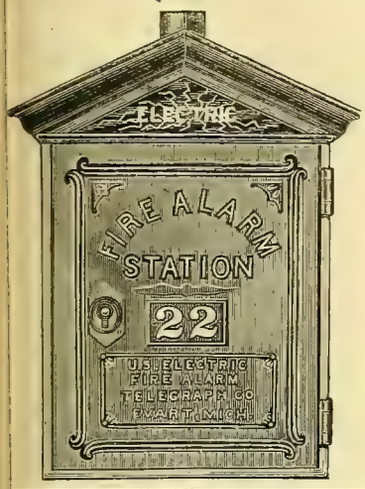

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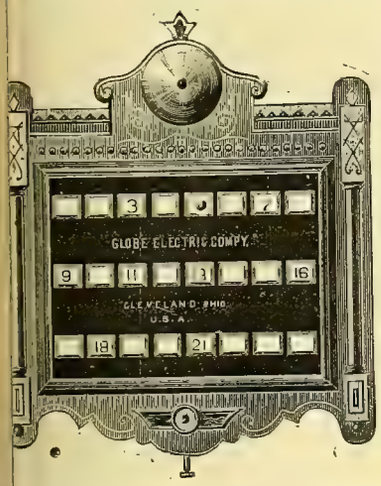

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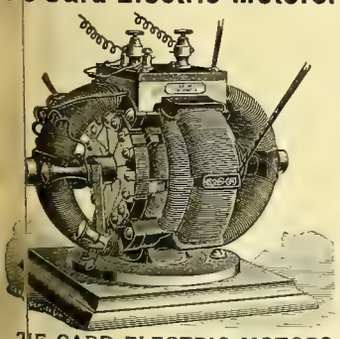

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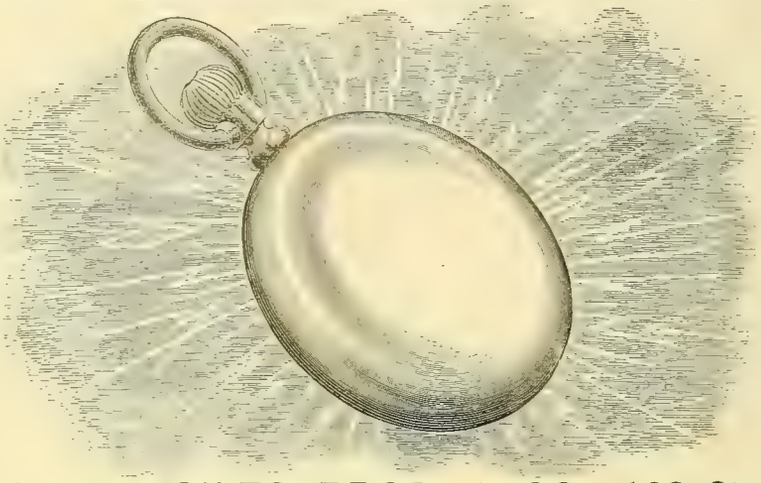

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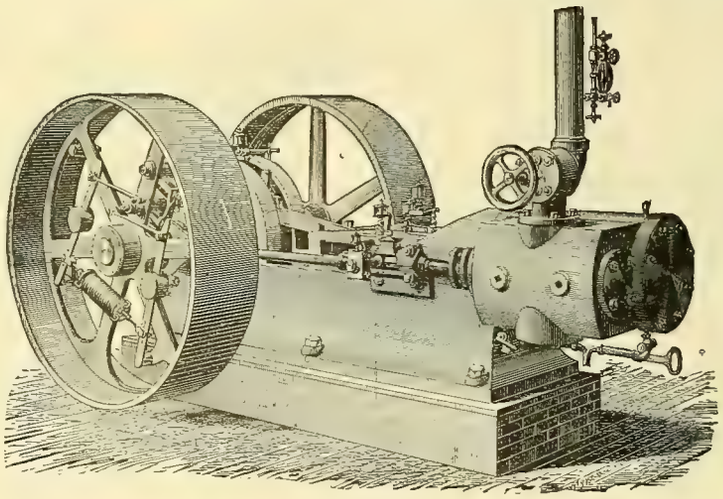

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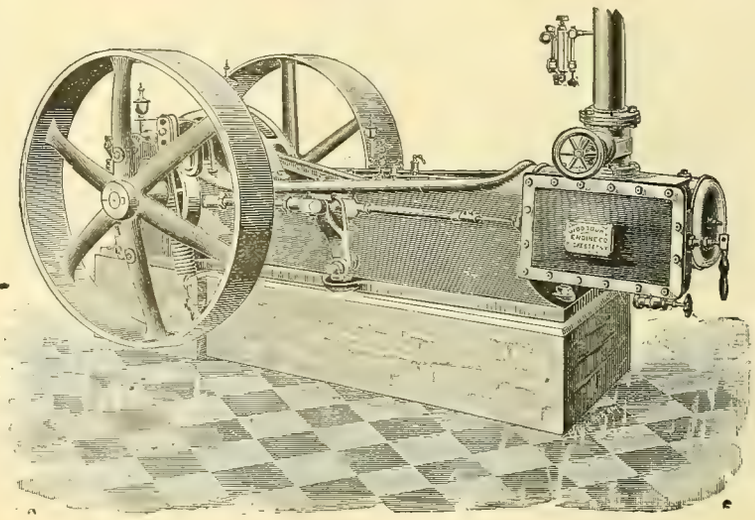

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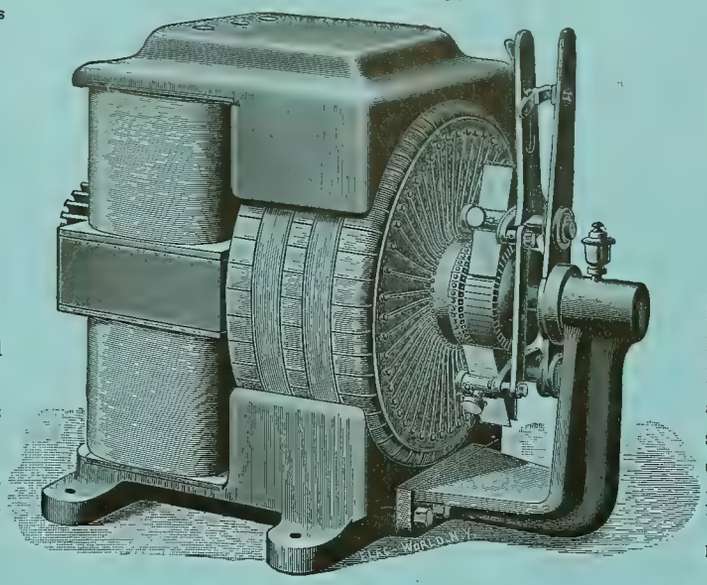

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Electric Railways

ARE IN OPERATION AT

Appleton, Wis., Scranton, Pa., Montgomery, Ala., Detroit and Port Huron, Mich., Windsor, Ont., Binghamton, N. Y., and Lima, O., and are being constructed at Ansonia, Ct., Brooklyn, N. Y., and St Catharines, Ont., Omaha, Neb., and Dayton, Ohio.

Estimates and Catalogues sent on Application.

Van Depoele Electric Lights Are in use everywhere and are daily growing in Popularity. Write for Illustrated Electric Light Catalogue.

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AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

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18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

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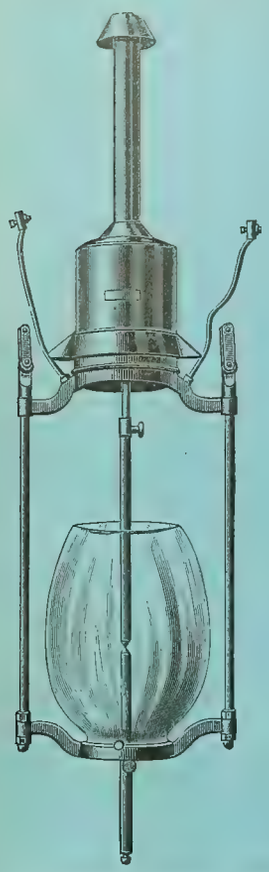

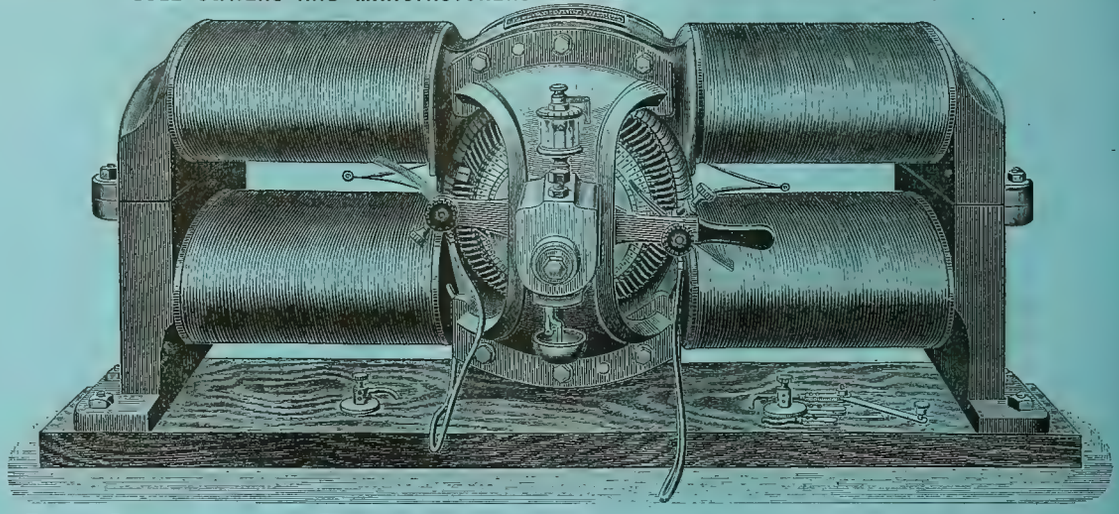

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AND THE PERFECTLY AUTOMATIC AND SELF-REGULATING

JENNEY ARC LIGHT.

The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

ONLY GOLD MEDAL

At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

This system HAS NO EQUAL for SIMPLICITY, DURABILITY and STRENGTH OF LIGHT.

We have the Only Perfect Working Headlight for Steamboats, with Focusing Reflector. Full information furnished on application.

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MANUFACTURERS OF

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—AND—

Incandescence

ELECTRIC

Lighting Apparatus.

Electric Motors!

CARBONS FOR ARC LAMPS, Etc., Etc.

Chicago agent, ALEXANDER KEMPT, 130 Washington St.

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Gutta Percha Insulation.

Our Balata Insulated Flexible Cords

ARE SUPERIOR TO ALL OTHERS.

SEND FOR SAMPLES.

Western Electrician.

EVERY SATURDAY.

Vol. I. CHICAGO, DECEMBER 10, 1887. No. 24.

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GEO. WESTINGHOUSE, JR., President. C. H. JACKSON, Vice-Pres. & Gen'l Mg'r. JOHN H. DALZELL, Treas. J. W. MARSH Secretary.

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For Telegraph, Telephone, Electric Light and Power; Underground, Submarine and Aerial.

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Five Years of Uniform Success Enable us to Guarantee our Cables.

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BITITE and TRINIDAD

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ELECTRIC LIGHT WIRES of all sizes a SPECIALTY.

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The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power. Telegraph and Telephone, Railway and all other Branches of Signaling.

All Sizes *Lead Encased Wires.* Aerial Use, Subterranean Use, Submarine Use Concealed Wiring in all Locations.

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Patents bought outright, or inventions handled on royalty.

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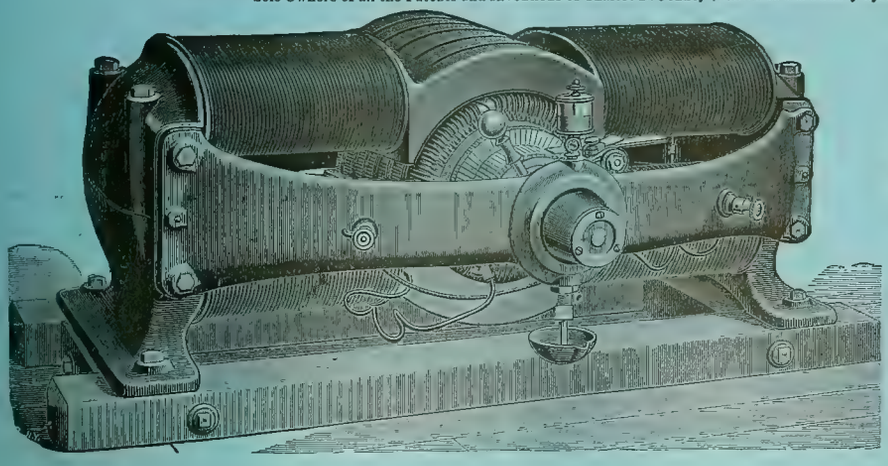
JENNEY ELECTRIC COMPANY.

OF INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp & Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Arc-Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

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INDIANAPOLIS, IND.

The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

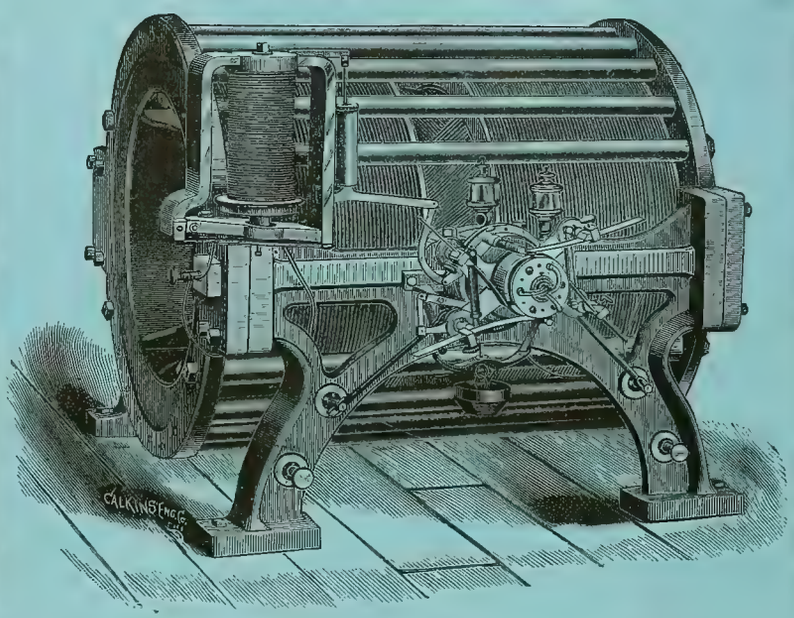
OF

Electric Arc-Lighting

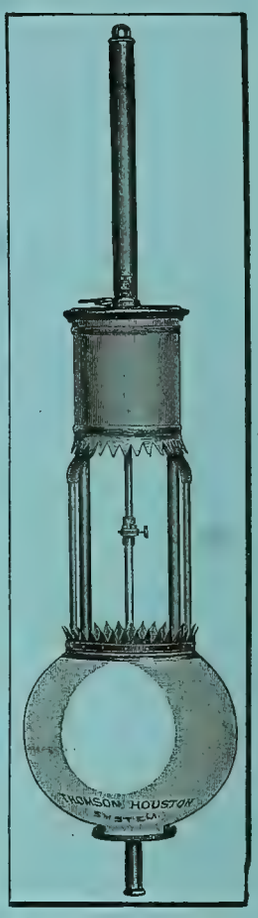
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

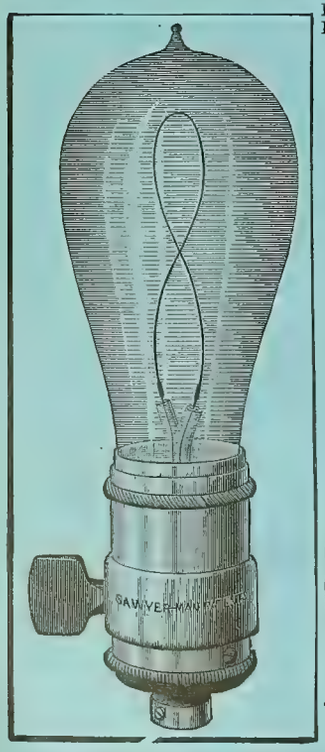


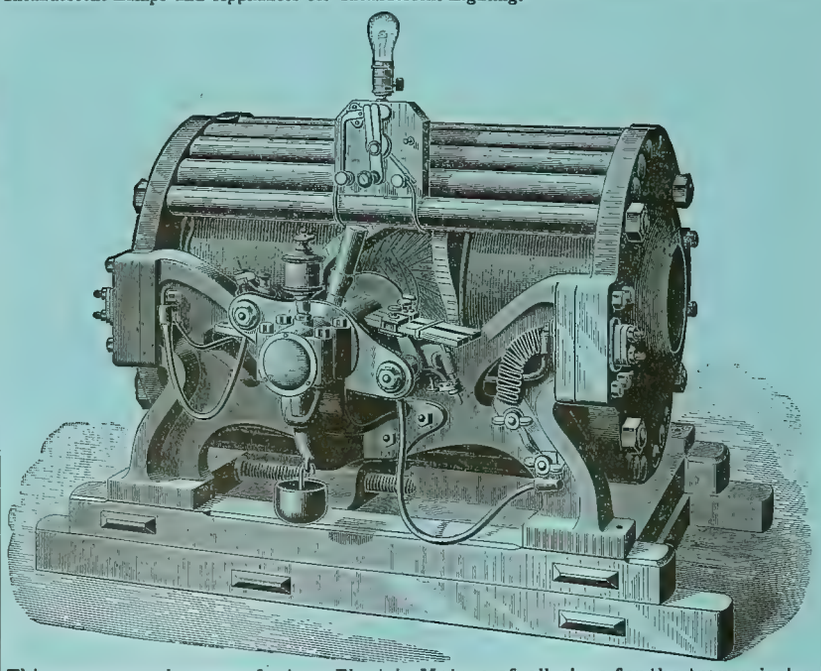
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT **LONG DISTANCE INCANDESCENT LIGHTING.**

These dynamos are automatic in their regulation and will maintain a uniform ight, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

EDISON'S NEW LAMP

IN

People's Theatre, Minneapolis.

12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

MINNEAPOLIS, NOV. 17, 1887.

EDISON UNITED MANUFACTURING CO.,
65 Fifth Avenue, N. Y.

GENTLEMEN:

The Electric Light put in my Theatre by your company is far beyond my expectations. Its system of lighting is perfect and is all that your representative claims for it.

Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,

LAMBERT HAYS,
Proprietor People's Theatre.

Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO, 185 DEARBORN ST., CHICAGO.

READ THIS.

Points.

Economy of Power.

Durability of Lamps.

No Discoloration of Globes.

Precision of measuring Instruments.

Greater Simplicity.

Less wire per lamp.

IN SHORT,

the most for the least money.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN

Chicago, May 20th, 1887

DICTATED

J. F. Conklin, Mngr.
Grand Opera Hours,
Minneapolis, Minn.

Dear Sir,

Your telegram of the 19th is received, reading follows,

"C. C. Warren,
216 LaSalle St. Chicago.
"We started big and little dynamo on one engine- had nine hundred and sixty lights- worked magnificently- run entire evening- We are much pleased."
J. F. Conklin."

I am very much gratified at the receipt of the telegram and thank you heartily for it.

You will greatly oblige me by answering the following questions.

Yours truly, C. C. Warren
MANAGER WESTERN DEPARTMENT,
The U. S. ELECTRIC LIGHTING CO.

Questions.	Answers.
I understand the above telegram refers to the two Dynamos put in your engine room by the U. S. Electric Lighting Co. as follows,- One 300 light and one 500 light Dynamo- and are used for lighting the stores and offices in the Syndicate Block- and is additional to the 600 light plant previously insyalled by the U. S. Co. for lighting the Grand Opera House; all the dynamos being located in the Syndicate Block engine room, and driven by two New York Safety 12 x 12- 75 H. P. Engines. One engine driving the two 300 lighters for the Opera House, and One engine driving the 500 and 300 light dynamos for Syndicate Block. Is this correct?	Yes
What steam pressure at boilers was employed when operating the plant as per above telegram?	90 lbs
At what voltage were the lamps burned?	110 Volts
I understand that you contracted with the Edison United Mfg. Co. of New York for a 300 light dynamo with wiring for the Syndicate Block; their proposal for wiring was on basis of no loss in electrical pressure, and the dynamo to yield 8 - 16 candle power Edison lamps per horse power. When plant was finished, wiring was found so unsatisfactory, and a great loss in electrical pressure instead of "no loss", and that you were induced to make contract with the Edison Co. wholly on account of the low price they offered their apparatus as compared with the U. S. Co's. proposal. Is the above correct?	Yes
When indicating the engines driving the Edison Dynamo, how many lights were being burned?	348
What amount of power was required to run the 348 lights?	54 HP
After obtaining the above data concerning the Edison apparatus, and ascertaining that their guarantees fell so far short of being fulfilled, did you reject the Edison plant and substitute it by a U. S. 300 light plant? And shortly afterward increase further by putting in 500 more lights in the Block, and a U. S. Co's. 500 light dynamo additional? to which the telegram quoted in letter refers?	Yes
When indicating the Opera House plant of 300 U. S. lamps, I understand there were 600 lamps being burned; and indications were made at same time the Edison plant was indicated. Please state what amount of power was required for the 600 U. S. Lamps operated by the two 300 light dynamos, and driven by the N. Y. Safety 12 x 12 Engine.	53 HP

C C Warren Esq
Dear Sir. I have written the answers opposite your questions above as per your request and trust they may be of benefit to you. I have been so thoroughly satisfied with your lighting system, after having used it so long in the Grand Opera House, that the successful start of the Syndicate Block plant is no surprise to me
Yours truly J F Conklin

The above letter explains fully the DISPLACING of the Edison System by the UNITED STATES SYSTEM in the Syndicate Block, Minneapolis, Minn., and gives data regarding tests made of the two systems. Address:

C. C. WARREN, Manager Western Department, 216 La Salle St., Chicago.

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CLEVELAND, O.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

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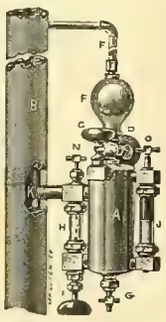

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Are pronounced the best by more than 20,000 users. They are especially adapted to

HIGH SPEED ENGINES FOR ELECTRIC LIGHTING

Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

Liberal discount to the trade. Send for Circular and Price List.

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ENGINEERS AND CONTRACTORS OF

Steam and Hydraulic Machinery.

Complete Steam Plants for Electric Light and Power.

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Holmes, Booth & Haydens,

25 PARK PLACE, NEW YORK.

MANUFACTURERS OF

Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

Western Agency, 185 & 187 Dearborn St., Chicago.

Geneva Non-Magnetic Watch Co.

(LIMITED.)

Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode.

Ask your Jeweler for them.

Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the works, they require no shield or other protection.

Send for Catalogue.

177 & 179 Broadway, New York.

THE MATHER ELECTRIC COMPANY

MANCHESTER, CONN.

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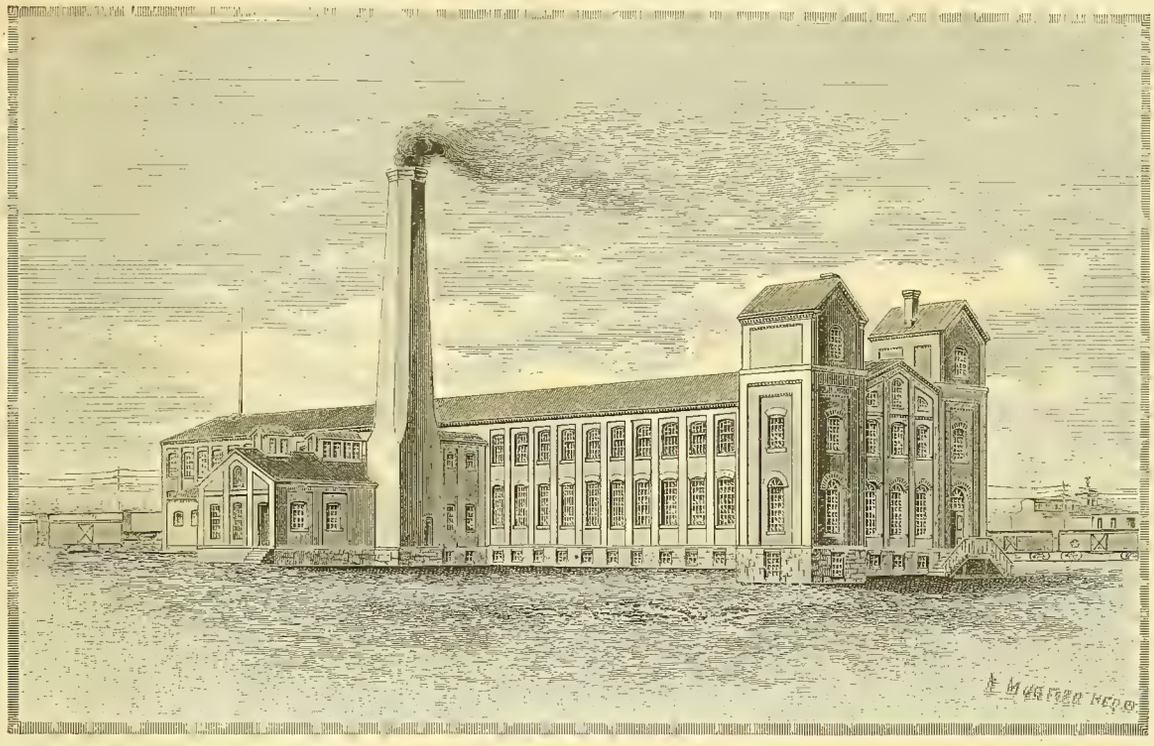
R. H. MATHER, WM. A. ANTHONY, Consulting Electricians.

New York Office, 35 Broadway. Chicago Office, 38 LaSalle St. Boston Office, 143 Federal St. Cincinnati Office, Carlisle Building.



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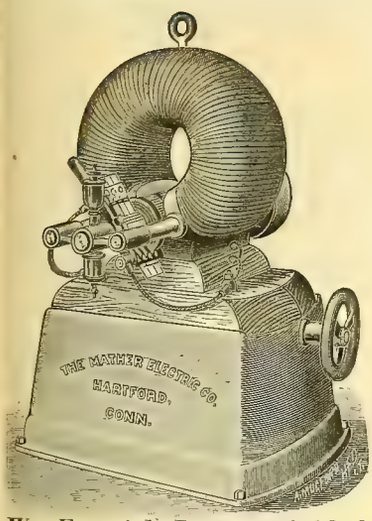
We make instruments for Electrical Measurements, adjusted to any degree of percision required for any purpose. Resistance boxes are made with any required series of resistances, with and without proportional coils for bridge. All resistances are adjusted to legal ohms by standards tested at the Cavendish Laboratory and certified by the British Association Committée.

IN RESISTANCE BOXES

required for physical research, all the coils will be made from one piece of wire, to insure a uniform temperature coefficient. Galvanometers are made of high and low resistance, aperiodic and astatic, or not, as required. Tangent Galvanometers of any capacity will be made to order. Ammeters, Voltmeters and Resistance Coils will be calibrated, and constants furnished.

The Mather System for Incandescent Lighting.



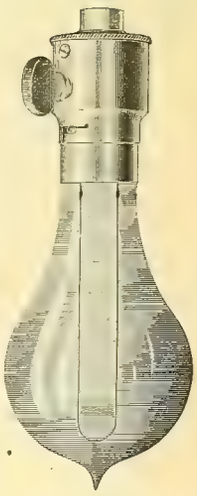
The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and

DO NOT BLACKEN IN USE.

Our Dynamo is very simple in construction, runs without spark at the commutators and can be operated by any one accustomed to the care of engines or machinery. The system has no equal for mills, machine shops, or other places requiring isolated plants. We shall be pleased to furnish estimates for complete installations, with or without motive power, and will send one of our experts to examine the premises, if necessary.

MOTORS.

We furnish motors from one-half horse power upwards, for constant potential circuits, perfectly self-regulating without special regulating mechanism. Motors are also furnished for constant current circuits.



Incandescent Lamps and Sockets for Private Users.

We Furnish Lamps of 16 Candle Power each, for Potentials from 50 to 110 Volts, for use with any Machine.

CHICAGO OFFICE, 38 LA SALLE STREET.

The Tucker Electrical Manufacturing Co.,

35 Broadway, New York City.

Selling Agents of the MATHER ELECTRIC COMPANY for the States of New York, New Jersey and Pennsylvania.

We have a considerable quantity of **KERITE WIRE** size No. 13 B. & S. Gauge, 6-32″ insulation, which has been in use, but is practically as good as new.

We will send a sample of this wire and quote a very low price to any one who inquires.

WESTERN ELECTRIC COMPANY

CHICAGO—NEW YORK—ANTWERP—LONDON.

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MANUFACTURERS OF **Automatic Electric Motors** (MATHER PATENTS.)

In all sizes from ½ H. P. upwards. The efficiency of these Motors is over 92 per cent. They require no rheostat, are perfect in regulation, simple in construction, and thoroughly and substantially built. Also manufacturers of

THE MATHER DYNAMO ELECTRIC MACHINE,

FOR ELECTRO-PLATING, ELECTROTYPING, COPPER REFINING, ETC.

These Machines cannot reverse, use no water, do not spark, and are noiseless. Satisfaction Guaranteed.

THE EDDY ELECTRIC MANUFACTURING CO., HARTFORD, CONN.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, DECEMBER 10, 1887. No. 24

Chloride of Silver Medical Batteries.

We show on this and the succeeding page a number of illustrations of the Barrett chloride of silver medical batteries and their parts, the inventions of John A. Barrett of the Elektron Manufacturing company of New York.

The basis of the batteries is the chloride of silver cell, upon which six years of experimental labor have been expended, with the idea in constant view of ascertaining the various causes of failure which had destroyed the usefulness of the chloride of silver element, and one by one removing the difficulties in the way of its use.

Commencing with the use of this cell, for a portable galvanic battery, Mr. Barrett has adapted it to all the requirements of Faradic coil work, and has designed and introduced a series of chloride of silver Faradic instruments which it is claimed are absolutely perfect and in advance of any apparatus ever offered to physicians. The claimed superiority of these batteries consists in the great advantages of the chloride of silver dry cell by which the coils are operated, the scientific and mechanical perfection of the details of the coils, the simplicity and accessibility of the parts of the apparatus and the high grade of workmanship with which the whole is constructed.

The batteries consist of two principal parts: The battery box or outside case, with pole changer, cords and electrodes, and the inside case, which incloses and contains in a solid pack the cells of which the battery is made up. The inside case is, in fact, the essential portion of the battery, with connections and studs complete, and can be readily removed from or returned to its place in the battery box. In the form in which this inside case is made, it is immaterial which side up it is stored or carried, as there is no free fluid and no possibility of leakage. The renewal of the battery when it has completed its term of service is accomplished by an exchange of the old inside for a new, thus supplying the user with a complete new battery, as far as the essential parts are concerned, at each replenishing. This battery, as prepared for physicians, is the same as that now employed as the standard test battery by the leading electricians in this country.

The strength of the current is constant. The battery is not weakened by work. The power to furnish the required quantity of electricity is stored in the stable and insoluble compound, chloride of silver, and as long as the smallest portion of this remains upon the silver plate, the chemical relations of the elements remain unchanged, and the electromotive force of the battery is undiminished. The battery does not waste when not used, as the zinc and silver elements remain intact as long as the battery stands on open circuit. The connections of the battery are entirely free from corrosion. The silver wires which are attached directly to the zinc and silver plates in the cells, are passed up through the caps and plate, and fastened down under nuts which screw upon the connecting studs. There are no connections underneath the plates. The nuts and ends of the silver wires are on the top of the plate, easy of access, and entirely removed from moisture or corrosion. The battery is portable in every respect. A fifty-cell battery measures 6 x 7 x 10 inches, and weighs, with electrodes, 11 pounds. To use the battery it is necessary only to open the cover, connect the electrodes, and select the number of cells desired. A current reversing switch is provided in the cover of the box. A tray of electrodes is a part of each complete battery. The elements are permanently in the cells, and do not require to be raised and lowered as in acid batteries. No part of the cell needs to be changed during the life of the metallic elements, that is, for two years or more of regular medical work. There is no gas or odor about the battery either when in use or idle. The zincs do not require amalgamation.

Fig. 1. represents a complete fifty-cell battery in its box, with pole changer. The battery box is of selected mahogany, with piano finish and unbreakable joints. The pole changer is one designed especially for this battery, and is very simple and serviceable. The selecting plugs which fit the battery studs are attached to the pole changer by flexible conducting cords.

Fig. 2 shows the inside case removed from the box. The top of this case through which the studs and wires pass is of black rubber; the sides and bottom of the case are of ebonized wood. This case slips readily into the box, and can be as readily removed. When the inside case is in place, a numbered and polished black rubber top plate is laid over it, covering the nuts and washers and the lifting buttons of the case, and exposing only the connecting studs.

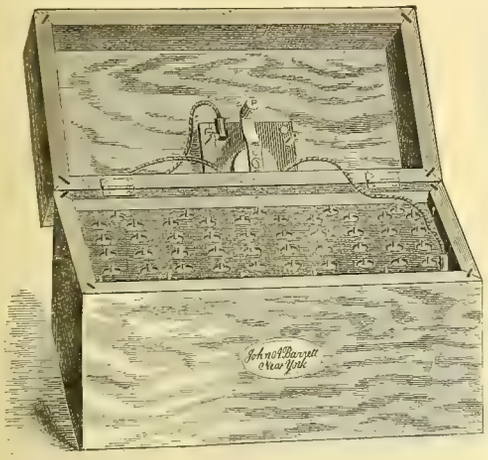

Fig. 1.

Fig. 3.

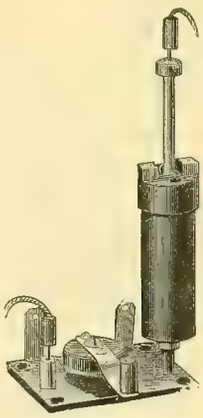

Fig. 4.

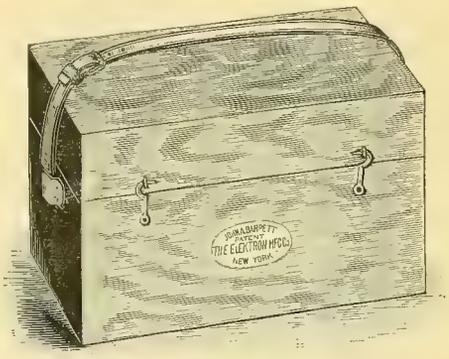

Fig. 6.

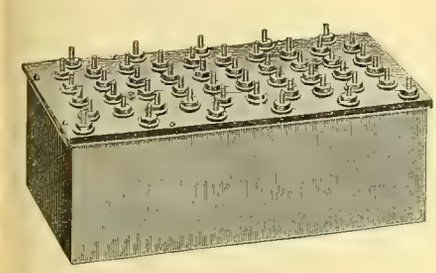

Fig. 2.

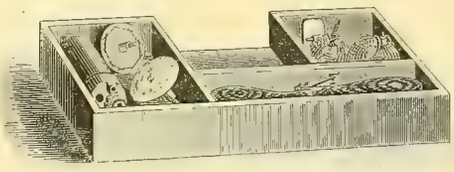

Fig. 5.

Fig. 7.

Fig. 3 shows the water rheostat which accompanies every battery, and Fig. 4 represents the method of attaching it to the pole changer for use. The cap of the rheostat is to be unscrewed. The cylinder should then be filled with water, and the cap replaced. The thimble in the bottom of rheostat should be slipped over either post of the pole changer and one conducting cord attached to the upper end of the plunger rod. The other cord should be attached as usual to the other pole changer post. The plunger rod of the rheostat should be drawn up to its highest limit, and the sponges applied to the patient, a proper number of cells being selected, and the pole changer handle turned as desired to right or left. The plunger rod should then be carefully and

gradually pushed down, until the desired strength of current is found to be passing. The rheostat should be emptied after using.

Fig. 5 shows the tray of electrodes which accompanies every complete battery. This tray is of ebonized wood, and contains the regular outfit of cords and electrodes, and rheostat. When the battery is to be closed, the place for the tray is on the top of the connecting studs, so that the box cover shuts down over it.

Fig 6 is a complete fifty-cell battery box closed, showing strap for carrying the battery. This strap is attached to the body of the box and not to the cover.

Two other regular sizes of the complete battery contain 32 and 24 cells respectively. These are placed in the same box as the 50-cell battery, for the reason that smaller boxes do not hold conveniently the pole changer and electrodes.

A second style and grade of battery from the same cells is put up in numbers from 25 cells down. These are placed in black walnut boxes with small compartments for sponges and cords, and without pole changer.

Fig. 7 is an illustration of a 16-cell battery of this description. This style of battery is designed especially for private use.

Fig. 8 is an illustration of a combined 50-cell galvanic battery complete, with a powerful Faradic coil in the same box. One type of this cell fitted to work the coil in the combination set is shown in Fig. 9. This cell is a compact solid block without fluid, and always ready for action.

The dimensions of the single cell for the combination battery are 6 x 3 x 1 inch. It will run the coil steadily and without attention for a great length of time, and can be slipped out and exchanged for a new cell when exhausted.

Fig. 10 shows the coil removed from its place in the battery box, and the elektron silver cell in position for service. The cell remains in position during its long life. No changing or cleaning or placing of zincs is required. The coil is simple in construction and gives a smooth and powerful current instantly upon the moving of a switch lever.

Fig. 11 represents a physicians Faradic battery. This battery contains two of the Barrett elektron silver cells, which may be used singly or in combination. The primary coil is attached rigidly by a supporting bracket to the base upon which the cells rest. This base is so fitted to the box that it is firmly secured in place by a single screw, and by turning back this screw, may be removed and inspected in every detail. The buzzer and automatic switch are specially designed for smoothness, simplicity and perfection of operation. Two distinct secondaries are provided; one of very fine wire, giving high potential, the other of heavy wire, giving a large quantity. Either of these may be used at will, and supply the means for making important distinction in induced effects. The regulation of the current is by the well-known Dubois-Raymond plan of sliding the secondary over the fixed primary coil. The box is of mahogany with panelled faces and high finish. The dimensions are 10 x 7 x 2½ inches.

Fig. 12 shows one of the cells of this battery. It is solid and dry. It slips into place between spring clips on the base of the coil, and is always ready for action on the turning of a switch. Figures 13 and 14 show the Barrett elektron silver cell put up in a shape for miscellaneous work where such cell is desirable. These cells are solid and dry. They are furnished for the present to order only, of a capacity as required up to 6 watt-hours. These cells are in use for electric bells, working models, induction coils and telephones, and for miscellaneous electro-magnetic work.

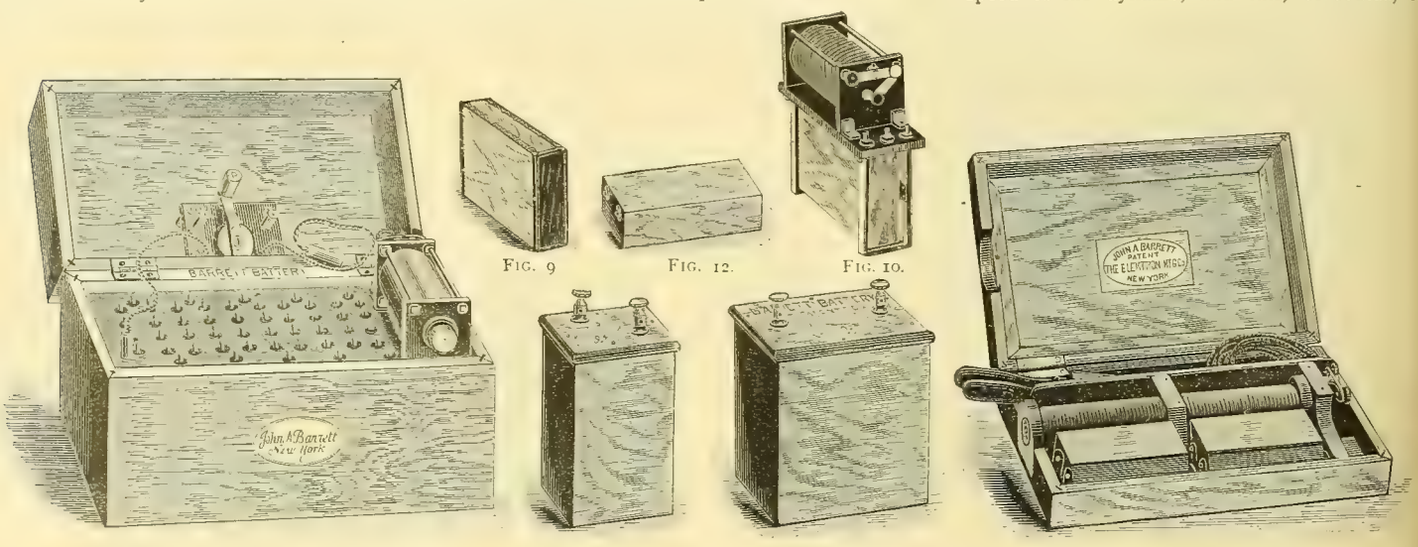

Fig. 9 Fig. 12. Fig. 10.

Fig. 8. Fig. 13. Fig. 14. Fig. 11.

An Electrical Type-Setting Machine.

The Minneapolis, Minn., Electro-Matrix company, with a capital stock of $1,000,000 has been incorporated. The company control a machine designed by A. S. Capehart, S. G. Goodson and C. L. Redfield for setting type, or rather for making a matrix from which casts can be taken. The letters are punched into a strip of cardboard the width of a column, from which a stereotype is made in exactly the same manner as stereotypes are now made from pasteboard matrices. The work of punching the dies in, of feeding in the cardboard, and of preparing it for the next stroke is all done by electricity. The operator simply has to push the die plate to the right place, and strike the key. Mr. Redfield thinks the invention will create as much of a revolution in printing as Gutenberg did. He points out that the application of electricity to the work opens up a field the wideness and novelty of which makes it difficult of comprehension. For instanc he says there is nothing to hinder a press agent in Chicago from sitting down to his machine and simultaneously making matrices on similar machines in Minneapolis and St. Paul, Milwaukee, Kansas City, and Omaha. One man operating the electro-matrix machine will supplant at least five men setting type.

The Florida Electrical Society.

The Florida Electrical society has been organized at Jacksonville, Fla., with the following officers: B. F. Dillon, president; L. E. Spencer, first vice-president; W. R. Davis, second vice-president; G. W. Davis, of Palatka, third vice-president; J. S. Arnold, of Sanford, fourth vice-president; E. B. King, secretary; D. J. Crowley, treasurer; R. B. Rood, librarian. The objects of the society are the advancement of electrical knowledge among its members, the establishment of a library, a reading room and a laboratory, and the holding of periodical meetings, at which the reading of scientific papers and their discussions are to be the leading features. With energetic Superintendent Dillon at the head, the society should take a prominent stand.

It is said that the longest tunnel in the world, commenced in 1782 and finished in 1878, drains the Schemnitz mines in Hungary. It is 10.27 miles in length.

Waldumer Electric Brake Tests.

In No. 15 of the Western Electrician, note was made of tests of the Waldumer electro-magnetic brake on the Cincinnati, Washington & Baltimore railway near Cincinnati, September 27th and 28th, 1887. These tests were made under the supervision of Lewis M. Hosea, by direction of W. S. Cappeller, commissioner of railroads for the state of Ohio, and the report of Mr. Hosea has but recently been made. From that official report the appended is taken:

The mechanism of the Waldumer brake system is as follows: A series wound dynamo incased with and driven by a direct coupled three-cylinder engine supplied with steam from the locomotive boiler, is placed upon the running-board of the locomotive, Fig. 1, and constitutes the entire generating outfit of the "straight brake" system. The combined engine and dynamo occupy a floor space, about sixteen by twenty-eight inches, fourteen inches high. The dynamo has a twelve inch Gramme ring, five inches face, with a field resistance of .66 ohm., and an armature resistance of .7 ohm, and is speeded to a maximum of 1,000 revolutions per minute.

A hand switch with graduated resistances is provided, by which the engineer controls the current to the brakes. A half-throw of the lever gives sufficient current to take up all the slack in brake-chains and shoes, and a full throw gives full ordinary braking power, which is increased as necessary by a graduating throttle valve by giving the dynamo-engine more steam. The strength of current is in proportion to the speed of the dynamo, and this, of course, to the steam power supplied to the driving engine.

The brake-setting apparatus, Fig. 2, under each car, consists substantially of an iron spool wound as a magnet, and incased in a loose drum carrying a sprocket wheel having a chain belt connection with a winding shaft upon which the brake-chain is wound. Upon energizing the magnet, the attraction of the spool-flanges is exerted upon iron bars held loosely between and by the heads of the enclosing drum. By the friction thus produced, the drum is rotated with the magnet, the latter being in constant rotation from the car axle by chain and sprocket wheel connection. Except when the magnet is energized, the drum and brake-chain shaft remain inert, and upon discharging the magnet the slack of the chain immediately restores the drum to its original position.

The electric conducting system is over a single conductor—the generator being grounded at the driving wheels of the locomotive, and the brake magnets being connected with the conducting main, in multiple arc, and grounded at the car wheel pedestals. The main conducting system, when proper conducting wires are not provided, is over the truss rod of the car inter-connected by flexible, short conductors incased in rubber hose, Fig. 3. These are attached by screw clamping heads to the ends of contiguous truss-rods and coupled by interchangeable coupling heads, somewhat similar to those of the air brake.

The automatic apparatus consists of a dynamo generator, similar to that upon the engine, located in the caboose, and driven by a chain and sprocket wheel connection from one of the car axles. While the engineer's circuit is in use, a relay in the main circuit is energized and the auxiliary dynamo remains cut out. Any break or failure of the primary circuit, however, such as parting of the train, at once closes the auxiliary circuit on the main conductor and a ground at the caboose wheels and sends a current to all the brakes of the train as far as the conductor extends. Thus in case of a train parting, the forward portion remains under control of the engineer, while the rear portion is automatically controlled by the auxiliary dynamo.

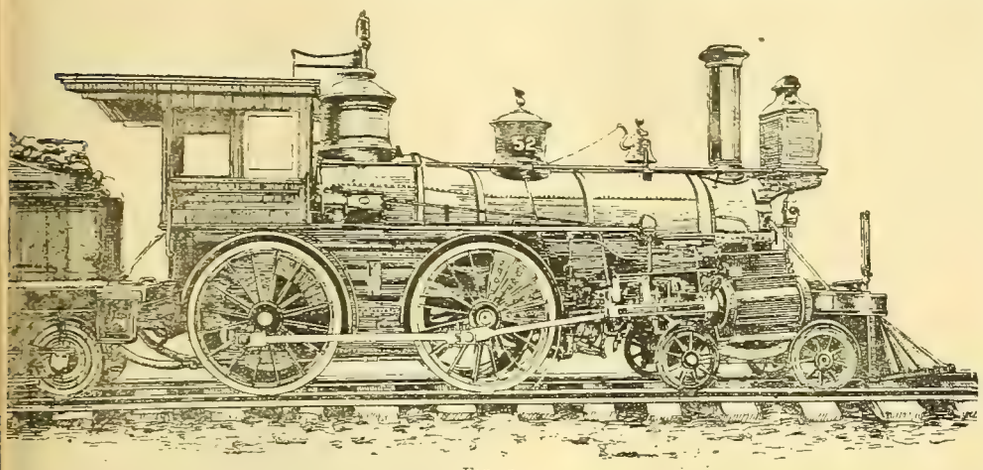

Fig. 1.

The train provided for the trial was an accommodation, on which the Waldumer brake is in regular daily service, consisting of an engine weighing 35 tons, one baggage and three passenger coaches. To these were added the private car of General-manager Stewart, one flat (gondola) car, and one ordinary freight caboose, these also equipped with the brake, making in all seven cars besides the engine and tank, of a total length of about four hundred feet. The brakes and break rigging throughout were the ordinary mechanism in daily use, provided with common hand wheels, and belong to the railroad company. The Waldumer company had simply added to these its winding drums, generators and electrical connections. The train was, in fact, equipped with three brake systems, each independent of the other, and capable of operation without interference. The Waldumer system, the air brake and the hand brake.

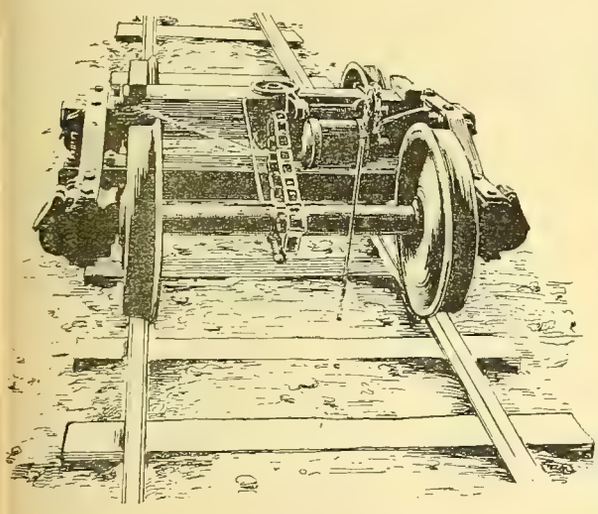

Fig. 2.

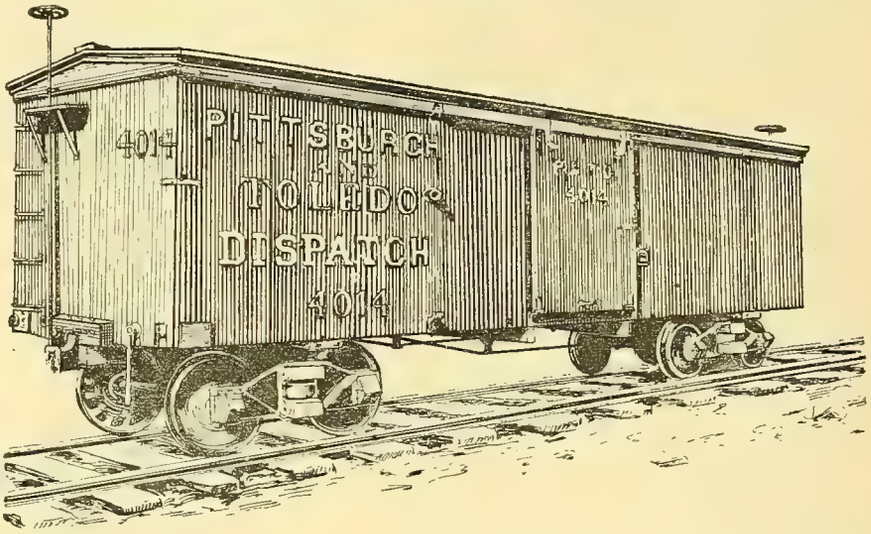

Fig. 3.

The train was run to Norwood, about ten miles from Cincinnati, where the tests were to be made under various emergency conditions, and upon the Norwood grade—a continuous grade of fifty feet per mile, two miles long. On the first day the rails were "greasy wet" as termed by trainmen, and no sand was used at any time. On the second day the rain that had fallen continuously the preceding day, partially subsided, leaving the rails somewhat dry.

First Emergency Test.—The passengers having disembarked at Norwood, a white and a red guidon were planted at the side of the track, 330 feet apart (1-16 mile), observers posted to note speed, distance and other details, and the train backed to and beyond the summit of the grade about three-fourths of a mile. The engineer was instructed to run down at utmost speed, shut off steam at the white guidon and apply brakes at the red guidon. Results were as follows: Speed at guidons, 45 miles per hour; dead stop in 33 seconds; distance run from red guidon, 1,200 feet (to engine pilot); release, instantaneous. The character of the retardation, as felt upon the engine, was perfectly steady and uniform. Down to a speed of about 8 miles per hour the retardation was strong, but gradually lessened as the train slowed down so that the actual stop was scarcely perceptible. Sliding of the two gondola wheels was observed in this test, due to the flat wheels reported before starting; otherwise there was no sliding of wheels, at any time throughout the test.

Second Emergency Test.—The foregoing test was repeated, under precisely the same conditions, with results as follows: Speed at guidons, 47 miles per hour; dead stop in 32 seconds; distance run, about 1,100 feet; character of stop, steady and uniform, without shock; release instantaneous.

First Break-away Test.—The train was again backed beyond the summit of the grade and run down at full speed. At the white guidon steam was shut off, and the pin, coupling the engine tender and baggage car, was drawn, and at the red guidon engine broke away, severing the electric coupling by its jerk and leaving the train to run down with full momentum. Result: Speed at guidon, 47 miles per hour; brakes began to hold immediately after break-away; dead stop, 36 seconds from break-away; distance, 1,400 feet; character of stop, steady and uniform, without shock. Down to about a speed of 6 miles per hour the retardation was strong, but the "drifting" of the train continued slightly longer than before, which was ascertained to be due to the straightening of the S link in the caboose brake-chain, which relieved the brakes of that car at slow speed.

Speed Graduation Test.—The train, having backed to the station, was started down the grade at full speed up to 30 miles per hour, when steam was shut off, brakes applied, speed was reduced to 15 miles per hour, and maintained at the latter rate to the bottom of the grade, by brakes, against the momentum due to gravity. There was absolutely no shock, surging or "bunching" of cars, and the link and pin couplings of the flat car and caboose scarcely changed positions during the entire run.

The same train and apparatus were employed the second day and the tests of the preceding day were repeated but without duplication.

Emergency Stop.—Speed, 49 miles per hour; dead stop in 31 seconds; distance run with brakes applied, 974 feet; character of retardation uniform and without shock.

Break-away Stop.—Speed 50 miles per hour; dead stop in 22 seconds from break away; distance run with breaks 870 feet; retardation gradual and without shock.

Speed Graduation Test.—Speed 30 miles per hour, reduced to 15 and maintained with perfect uniformity to bottom of grade, without shock.

Foreign Car Test.—As before, freight cars were switched in and electric connections made by the flexible couplings attached to ends of truss rods. In some cases the projection of the rods beyond the holding nuts was so slight as to expose but two or three bolt threads to the engagement of the coupling device. It was ascertained, before proceeding further, that the brake lever fulcrum of the gondola had pulled off, owing to structural weakness of the ordinary brake rigging, thus rendering the brakes of this car useless. In consequence, a very slight surge was experienced in the general manager's car which was just ahead of the gondola.

The foregoing table summarizes the results of the stop tests.

No. of Test.	Speed in miles per hour.	Kind of Stop.	Grade in feet per mile.	Time in seconds.	Distance run in feet, from application of brakes.	Condition of Rail	Character of Retardation.
2	45	Emergency.	50	33	1200	Wet.	Easy. Uniform.
3	47	"	50	32	1100	"	Steady. No Shock.
4	47	Breakaway.	50	36	1400	"	Quick down to Drifting. No Shock.
5	45	"	50	35	1300	"	Same.
8	49	Emergency.	50	31	974	Dry.	Easy Stop. No Shock.
9	50	Breakaway.	50	22	870	"	Same.

Magnetism in Watches, and its Control.[1]

By C. K. Giles.

In considering the effects of magnetism on the time-keeping qualities of the watch, we must first ascertain the parts affected, and locate the points of attack, and then investigate by experiments and otherwise the *modus operandi* of the cause of this trouble, and its sources. The escapement, or vibrating, or moving parts, such as the balance wheel, balance spring, lever, scape-wheel, roller table, etc., are the vital points attacked by magnetism. These are made of steel, and as they vibrate in a magnetic atmosphere, they are crossing lines of force and their free movements are interfered with, necessarily, according to the strength of these lines of force. The adjustment of the escapement of the watch which is made for a reliable timekeeper must be very fine and delicate to meet the requirements, consequently very susceptible to any and all influences; for instance, the balance wheel of an ordinary watch must vibrate five times per second, and 432,000—or nearly one-half million—times per day, and these vibrations are primarily depending on the balance wheel itself; 2ndly, the balance spring; 3rdly, the roller and table in connection with the lever fork; 4thly, the lever and pallets in connection with the scape wheel, and so on through the train down to the motor force—the mainspring. Any influence brought to bear upon the balance wheel, or escapement, to change its vibrations 1-100 part, makes a difference of about 15 minutes per day; 1-90,000 part makes a difference of about 1 second per day; as the average linear space travelled over by the circumference of the balance wheel of the average watch in its vibrations is ¾ of an inch, then the measurement of the difference in vibration which will cause the change of time of 1 second per day, would amount to 1-120,000 part of an inch; as 1-40,000 of an inch is about the highest power of the microscope, it will be seen that a very small change in each vibration makes a large difference in time. The influences operating to produce this variation in time may be exceedingly small, therefore in searching for them we must magnify them just as the microscope is used to discover the microbes or baccilli, or germs of human disease. As an instance which may be readily understood of how the defect in a watch can be magnified and made apparent, I will state that it has been found that the light, delicate hairspring of a watch affects the rate by its weight, therefore its weight must be taken into account in the adjustment. To discover the ratio of weight and error, they have made a hairspring ten times the usual weight required, and by testing this, have been enabled to arrive at the ratio of error very closely. Operating on this principle, we must go to the very foundation or seat of magnetic force within the watch—as the effects of magnetism have a cause in the watch, as well as outside the watch—and magnify the molecular action and lines of force or influence to such an extent that we can see and estimate the aggregate effect. This condition called magnetism exists everywhere—it is the primary law, the ultimate fact—it is "inter-etheric and cosmic," and exists throughout matter and space—it is the dual force of nature at rest, the normal condition of the molecules of all matter is one of dual polarity, generally called positive and negative. Magnetism, as it exists in matter, is only a condition, and the directive force of this condition in the molecules of matter, or atmosphere, or ether, is polarity, and this polarity creates, or is itself, the line of force; the intensity of this polarity is the strength of these lines of force, and the inter-etheric nature of this force extends it through more solid matter as well as atmosphere. The molecule is the resting-place of this dual electro-magnetic force; every molecule of the atmosphere is divided into its own individual polarity, and arranges itself according to its neighbor; the mass of molecular atoms will arrange its polarity according to the existing conditions. The earth is the great primary magnet, and gives us the normal conditions of polarity existing in matter; any disturbance of this normal condition of polarity is where we get the phenomena of magnetic and electric effect. Scientists at present generally agree upon the molecular, or "atomic theory," and the latest estimate we have seen is that a cubic inch of atmosphere contains from 60,000,000 to 100,000,000 molecules; the same size mass of silver or brass is estimated to contain about one-half this number, and so on. This electric or magnetic force exists in dual form, positive and negative, and must be exactly balanced; any disturbance of this dual condition, results in some form of phenomena. The permanent displacement or annihilation of this dual condition of electricity or magnetism would be equal to creating a vacuum in the atmosphere—neither one nor the other can be fully accomplished. All the moving electric currents and magnetic conditions are looking for "satisfaction"—seeking their equilibrium, as water seeks its level; if the equilibrium is not found in the atmosphere, or matter above the earth, it is sure to be found in the earth; the earth is the great "clearing-house" of the disturbed equilibrium of this dual force. Our globe represents the aggregate polarities of all the molecules composing it, and, as a mass, it must be in a condition of equilibrium, or state of satisfied polarity; the movement of electric currents and magnetic conditions about the earth are but the means of the disturbed dual polar force to keep up the equilibrium of the whole. Electricity is the primary cause of the condition called magnetism. A bar of steel whose molecules have been put in a condition of intense polarity by an electric current becomes a magnet. In a piece of tempered steel these molecules are so compact that they are not free to move, and can not arrange themselves satisfactorily with the normal atmospheric polarity, therefore it may become what is called a permanent magnet, and will create a magnetic condition, equal in intensity to its own, in the molecules of atmosphere or other matter which impinge on its surface. It would appear then that the strength of magnetism, or of magnetic attraction, is the inertia of the molecule; when this is overcome, the polarities change, but not until then.

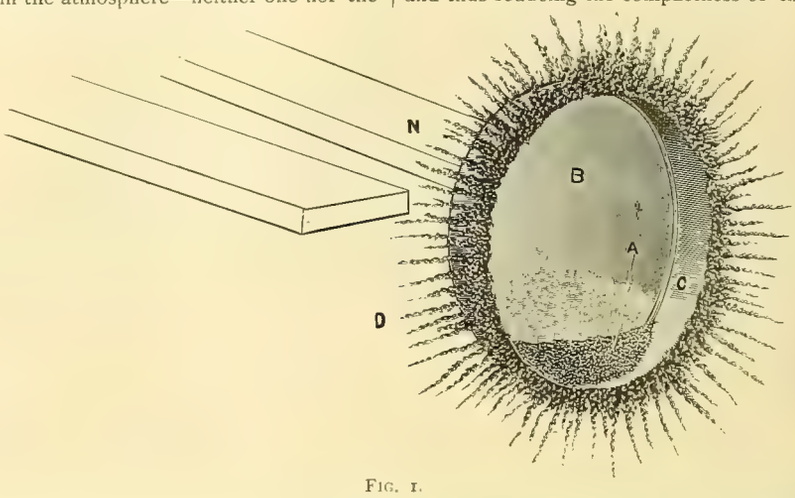

Fig. 1.

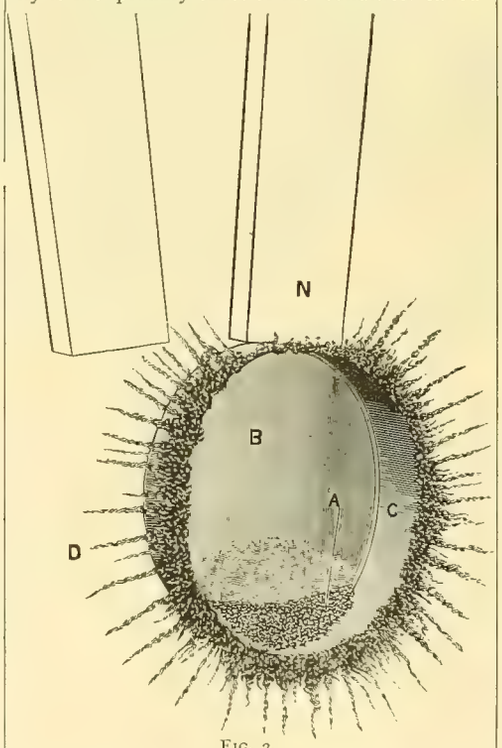

Fig. 2.

Electricity and heat are the most potent demagnetizers, or changers of polarities. Electricity acts as a demagnetizer simply by undoing the work it has done before, by reversing the polar condition it has caused; heat acts by expanding, and thus reducing the compactness of the molecules, allows them to resume their normal condition of polarity. Our globe represents the aggregation of nature's great dual forces in a state of equilibrium; it is the original magnet, and all the atmosphere, and metals, and matter on its surface, are polarized in harmony with it—in fact, to consider it more comprehensively and scientifically, our earth is but a cosmic molecule, moving in a cosmic medium through cosmic space, and all matter we know of are but atoms going to make up this cosmic molecule, therefore are of the same polar conditions as the earth.

We show here [referring to drawing] a sketch of this molecule—the earth; we know something of its physical laws and polar conditions, as taught by scientists, philosophers, astronomers and navigators. Here we have our dual polarity, north and south, and theoretical equator, where the two forces meet and equalize. As a mass, it is a complete molecule—its dual force is in equilibrium—at rest. In a very distorted way we attempt to show the condition of the atmosphere which surrounds the earth—if we can imagine a molecule of air magnified to the size of one of these little circles; all the molecules of air are polarized in accordance with the earth, that is, the dual polarities arrange themselves in equilibrium with mother earth, and the mass of atmospheric molecules surrounding the earth—as shown in the dotted circle representing the molecules of air or lines of force. Take any line of these molecules, extending (horizontally as regards the earth) from the pole to the equator, and they will have the same degree or condition of polarity, and any matter—a piece of iron, if you please—lying in the same horizontal plane will receive the same polarity; but if it is held perpendicularly, so as to cross a measurable space or number of these atmospheric molecules, then the mass of the molecules in the iron will arrange themselves just the same as a single molecule of air; the lower half will be of the same polarity as this half of our globe molecule on which we stand, and the upper half will be of the opposite polarity; with a little exercise of the imagination this will make visible to you the cause of the phenomena of the changing polarity of a piece of iron as we change its position as regards the earth—the jarring of the iron simply assists in overcoming the inertia of its molecules, so that they more completely fall into the directive force. This also shows the lines of force in which all moving matter on the face of the earth is subjected—our watches included. This atmospheric line of force is utilized by Edison in train telegraphy, and again these invisible lines cause practical electricians the serious trouble which they call induction. Every piece of metal

[1] Read before the Chicago Electric Club, December 5, 1887.

moving in this atmosphere must induce an electric current by crossing these lines of polarity, or lines of force. Every piece of iron or steel creates around itself a magnetic field or circle of force, induced by the magnetic conditions of its molecules. Every molecule of iron is but a small electro-magnet, and the aggregation of these is the bar magnet; this can be made more or less intense by manipulating it with more or less of electricity. This halo of force will be made by floating a piece of steel—a watch balance wheel, for instance—on a glass of water; take a piece of iron, a railroad spike, if you please, and lay it across the glass just over the balance wheel, and you will see the balance wheel move out from under the spike until it reaches a segment of the circle of this polar influence around the spike. This force seems to be in proportion to the bulk of the metal measured perpendicularly as regards the earth; if the spike is held perpendicularly, and the end presented to the balance wheel, it will be seen that this halo of force reaches much farther, and the balance wheel will be vibrated when at a much greater distance; by holding it a little nearer the balance wheel can be vibrated quite rapidly, showing that the lines of force are quite tangible. It will not make any difference which end of the spike is presented, as the polar conditions in the molecules of the spike are caused by the earth's force, and changed with every change of position as regards the earth. The same phenomena can be obtained with any piece of iron—an ordinary iron key, such as is usually carried in the pocket, will move the balance wheel floating on the water or cause it to vibrate when the end of the key is brought in close proximity to it. This experiment shows plainly that a watch may be affected by coming in the neighborhood of magnetic metals, such as will be found in any machine shop, or on a railroad, or by the metals carried in the pocket.

It is evident from the foregoing, that all the metals of which the watch is composed, are subject to the universal magnetic and electric influences, therefore, the magnetic condition within the watch must be cared for quite as carefully as the magnetic force outside of the watch, in fact, the conditions within the watch are the most important. The normal condition of all steel in the watch is one of polarity or magnetism. Sometimes this is quite intense, and sometimes merely normal; but every vibration or movement of the watch is across lines of force, and the rate of the watch will depend upon the conditions of this force; therefore, *magnetism* is the governor of the rate of the watch—every thing else being equal. If the mechanism is perfect, then the rate of the watch will be just what this subtle magnetic force allows it to be. When a watch has more than the normal amount of magnetism it should be demagnetized.

In demagnetizing a watch, we resort to the same force which magnetized it—that is electricity. The pieces of steel or parts to be demagnetized, are subjected to a rapid reversal of the electric current which changes the polarity, and at the same time, we slowly remove the article from the influence caused by the electric current. In this process the magnetic condition is discharged and recharged at every reversal of the current and by the slow removal of the article, we make each succeeding charge a little less than the preceding, and so on until the last charge is a minimum one, and the steel is reduced to its normal condition; it can not be entirely free; its molecules will still be in the state of polar intensity left by the last reversing charge. In this demagnetizing process, we arrive at what appears to be an interesting fact: The demagnetization is accomplished by displacing one part of this dual force, and replacing it with another, and

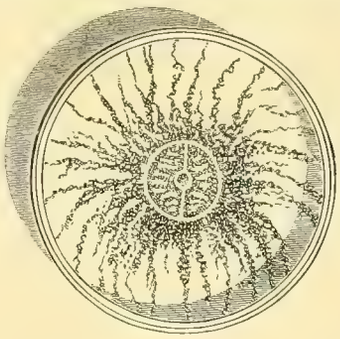

Fig. 4.

this displaced force moves out and seeks its equilibrium in its surrounding polarities; the molecules of the atmosphere which go to form the lines of force must be formed of the same dual forces as the molecules of steel, and subject to the same law—the line of force is but an elongated atmospheric magnet,—therefore as we change the polarity of the atmospheric molecule, the same as we do that of the steel; we displace one part of the dual force which makes this polarity and replace it with the stronger force which is causing the change. The displaced force must move on, and seeks its equilibrium by the nearest available conductor, a force is set in motion, an electric current created, and its source is in the molecule.

But this universal force which exists in the metals of the watch, this magnetic influence is not an unmitigated evil, but on the contrary is a decided advantage, when under proper control; like most of nature's forces—utilized, they are of immense benefit, while their attempted annihilation is equally detrimental. We can accomplish this control by utilizing the same natural law which causes the trouble, or use the same dual electro-magnetic force to protect the watch. This is accomplished by surrounding the watch movements with a circle or shield, or highly magnetic metal, which will secure the lines of force existing in any charged atmosphere, and hold them in a complete circle, or closed magnetic circuit where all of the enclosed space will be neutral, or in a state of satisfied polarity.

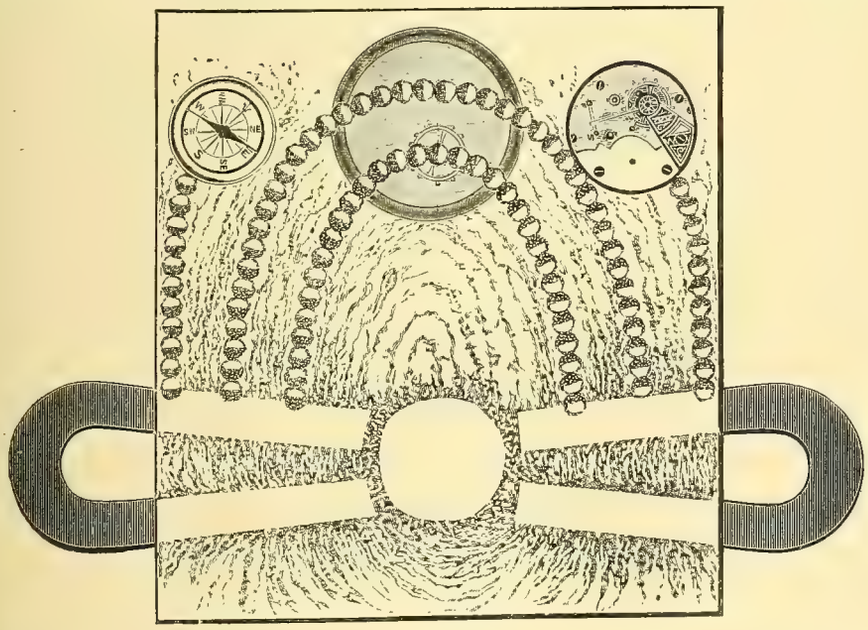

Fig. 3.

Exactly how this process is accomplished is made visible by a drawing, made from photographs of the experiments. This sketch represents the bar magnet, with a cardboard over it, and some soft iron filings scattered over the cardboard; by jarring the card board sufficiently to overcome the inertia of the weight of the iron filings, they will fall into lines of force which exist in the surrounding atmosphere. These are seen to be quite intense on the ends, but they find their equilibrium at the meeting point in the center of the bar where there is a theoretical equator or neutral line. Now if this bar magnet is bent into horse shoe shape, and using the same cardboard and filings, we have what is seen in the next drawing; the equator or neutral line is extended from the center of the curve up between the poles and through the lines of force at their meeting point, from A to B; a neutral condition is shown in the filings at A where the dual forces of the two poles meet and neutralize one another. Then again, if we form this horse shoe magnet into a complete circle, this same force which is shown to be intense at its poles, will be extended around the outer edge of the circle because they lack any satisfying condition of polarity, except what is found in the atmosphere, while the neutral condition, which is seen in the horseshoe magnet at A, and in the bar magnet at its equator, will be extended within the space enclosed in this circle, because the force from any point in the circle will be met by an equal force from another point—just as the dual forces in the horseshoe magnet meet and are neutralized at A.

The dual force within this closed magnetic circuit is resting in a state of satisfied polarity. This is shown in Fig. 1, which represents a shield cup, or box of highly magnetic metal, placed on one pole of the horse-shoe magnet, with its back in direct contact with the magnet; the iron filings adhere to the edges and on the outside surface with quite intense polarity, while the filings thrown in the box are perfectly free, and will fall out when the cup is reversed.

Fig. 2 represents the same cup with its edge, or one side, placed on one pole of the magnet, and held perpendicularly, and the iron filings applied as above. They cling with an equal degree of polarity all around the edge, but are free inside, as in Fig. 1, showing that the lines of force within this magic circle are not upset or distorted by applying the magnetic force to one side only.

This magic circle is again shown in another form, Fig. 3, which represents the cup, or box of shield metal, placed between two horse shoe magnets with cardboard and iron filings over it; the direction of the iron dust showing the lines of force, or the condition of the atmosphere surrounding the magnets, (the circles represent greatly magnified molecules of air or lines of force,) and the neutral space within the shield cup. A little to one side, but within the lines of force, are placed a compass needle, a watch balance wheel, floating on a glass of water, and a watch movement. The compass needle and balance wheel fall directly into the lines of force and remain stationary, but it will be seen that the balance wheel of the watch movement must be cutting these lines of force at every vibration, which must be a retarding power, equal in strength to these lines of force. If a magnet is passed through the field or lines of force on the opposite side you will see the balance wheel and the compass needle move and vibrate in response, showing that the lines of force are changed, and it is evident that the watch movement vibrating in this force must be correspondingly affected; but our closed magnetic circuit or shield circle remains the same and is uninfluenced. A watch movement placed within this circle will vibrate in permanently constant conditions, regardless of what disturbing influences are brought to bear by the law of the

(*Continued on page* 285.)

Western Electrician.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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A WEEK ago the November grand jury of Chicago returned true bills against fourteen bucket-shop keepers. It seems that only acknowledged bucket-shop men were singled out for prosecution, while open board of trade men and shady members of the big board were not called to account. It is probable that the bucket-shop men will conduct a vigorous defense.

RAPID transit on the west side in Chicago seems to be assured. The various merits of elevated and underground roads are being considered and the different methods of motive power are receiving thorough attention. The electric motor has been proposed and one or two systems have been presented before the executive committee of the Western Division Rapid Transit association, of which A. M. Wright is chairman.

THE suit brought by the Brush Electric company against the Faraday Carbon company for infringement of patents touching the copper coating of carbons is attracting considerable attention in the electrical world. Last week the Faraday, Standard, Globe and Parker-Russell companies formed a combination to defend the suit brought by the Brush company and a lively legal fight is imminent. Both sides have retained eminent counsel and the taking of testimony commenced this week in Boston.

A NEW phase is put upon the extended telephone litigation now going on, by the motion made before the commissioner of patents, Dec. 1st, by Elisha Gray to amend his original application for a patent by inserting the word "metallic" before the word "diaphragm." If this motion is granted it bids fair to re-open the whole matter. The Bell company are contesting the motion through Messrs. Conkling, Storrow and others, while Messrs. Casey, Young and Phillips represent Mr. Gray. The commissioner has made no decision as yet.

THE agitation in favor of a government telegraph is still kept up, especially in the east. Chauncey M. Depew, president of the New York Central & Hudson River railroad, says in a published interview that that government is best that governs least and that he is opposed to government purchase of existing telegraph companies. He adds, however, "I believe that it might be wise for the government to control all corporate power. Something in the nature of the interstate bill, if applied to the telegraphs, would probably remedy most of the evils now complained of. Competition ought to be kept up, rates maintained on a basis of equality to all, and some other objectionable features eliminated. All this can be done by legislation and without making the government a competitor in the legitimate channels of commerce and enterprise."

THE steadily advancing price of copper wire is causing no small amount of uneasiness on the part of manufacturers who have large contracts to fill and only small stocks of wire on hand. A month ago bare copper wire could be purchased for about thirteen or fourteen cents a pound, for ordinary sizes; last Monday in Chicago the price was twenty cents a pound, and the outlook was for an increase rather than a decrease. The advance is ascribed to the restriction in production of the Calumet & Hecla company who have been suffering from extensive fires in their mines, their inability to fill large contracts for export, a natural bullish tendency to elevate prices, and to the temporary closing of other copper mines. One dealer, who presumably has a large stock of bare copper wire on hand, expressed his satisfaction with the advancing price and made the noteworthy remark in connection that during the era of low prices, a large reel of wire, say 200 pounds, was rolled out of the back door and carted to the freight depot at a price that netted far less profit than a trinket or two, which could be carried out the front door by the purchaser. On the other hand, an electric light man, connected with a large manufacturing concern, who had 30 miles of circuit to build and not much of a stock of wire on hand, felt the reverse of jubilant. Copper men insist that prices will rule high until next March, at least, while purchasers are watching the market with great interest and awaiting developments.

WE give the second installment of Mr. Lockwood's article on practical telephony in this issue, the subject being the call bell, the principles that underlie its construction, its method of construction, and directions where to look for sources of trouble if any difficulties in operation arise. Mr. Lockwood defends himself from a possible charge of prolixity in his explanations by calling attention to the urgency of a thorough understanding on the part of those engaged in telephonic work of the elementary principles. An exhaustive presentation of elementary principles involves the use of many words, but we do not believe, when the intent of the series of articles is considered, that any fault will be found with them on the score of prolixity. On the contrary we have excellent authority that the eminently plain, practical and full treatment of the subject by Mr. Lockwood has already been appreciated. One writer located more than two thousand miles away from Chicago, expresses his thanks for the pleasure and profit he expects to derive from the articles. While he has been engaged for nearly three years in the telephone business and has under charge about 400 miles of line as well as two exchanges, he writes that he is ignorant of the mechanical part of the business, and hails the opportunity with pleasure. Closing his letter the writer trusts that future communications may be as clear and readily understood as the first, published in No. 21 of the WESTERN ELECTRICIAN.

THE article on magnetism in watches and its control, which appears in our columns this week sets forth very clearly the causes of magnetic disturbance and the means for its prevention, and also gives briefly a very clear exposition of some of the leading principles of magnetism, which, independent of their practical application, will well repay an attentive perusal.

If it were possible to construct a watch of materials practically non-magnetic throughout, magnetic disturbance could be eliminated, but, it is claimed, this is not possible, for while the balance wheel, which is the part chiefly affected, may be made of material approximately non-magnetic, nothing can be found to take the place of steel for the springs. But no metal or combination of metals, of which even the balance wheel may be constructed, is sufficiently non-magnetic to resist the powerful currents of the dynamo; but in the construction of the balance wheel the variation due to expansion and contraction with change of temperature is a consideration of still greater importance than that of magnetism; and here again it is maintained that steel must be used in the combination to produce the requisite compensation. Instead therefore of attempting to eliminate magnetism, the plan adopted is to neutralize its effects by the use of magnetic material as a shield in which to inclose the watch movement, forming around it a closed magnetic circuit; and also by constructing the rim of the balance wheel with a circle of miniature horseshoe magnets, neutralizing each other's effects and also the effects of the earth's magnetism; all of which is described in detail.

EXPERIMENTS with the electric search light as a means of defense have been made simultaneously, it seems, both on this side of the Atlantic and in England. In our correspondence from the east a few weeks ago mention was made of a test at Newport of the efficacy of electric lights for defending war ships from torpedo boats. The ship Dolphin was equipped with one light and the Atlantic with two. Torpedo boats approached them with all possible skill and quietness, yet their approach was readily detected. The naval officers in charge were satisfied that the electric search lamp was one of the best defenses against the attack of torpedo boats yet tried. The same conclusions seem to have been reached in England. Our English namesake says in regard to this matter: "Although the recent operations in the attack and defense of Langton harbor were conducted under unusually stringent conditions as to secrecy, it is stated, apparently on good authority, that both the war office and the admiralty have been strongly impressed with the great value of the electric search light in such operations. Electricity lends its powerful aid both in attack and defense, and equally above and below the water level; and now that the authorities seem at last to have taken up the question of coast defenses in something like an earnest spirit, there can be little doubt that a good many orders for arc light equipments will be forthcoming within the next twelve months. Dynamos and engines and quick-firing guns are less expensive to equip and to maintain than permanent fortifications; they are a good deal more mobile, and more easily procured than heavy artillery, and while it is of course essential that our naval yards and harbors should continue to be protected in the old-fashioned way, yet we may doubtless look forward to the period when without exception all points of our coast line where an invader might attempt to gain a foothold shall be within easy hail of the modern system of electrical defense."

IT is quite evident that by this time the American Bell Telephone company is cognizant of the serious error it made in attempting to force the people of Rochester, N. Y., to retain their telephones on terms dictated by itself. The story has been told and repeated, but it may be rehearsed once more. A year ago the Bell company declared its intention of substituting toll rates for flat rates, but the proposed new rates were regarded as exorbitant and the people of Rochester hung their telephones up and decided not to take them down again until the Bell company had made rates that were satisfactory to them. About the middle of last month, Colonel Parker, a genial, courteous gentleman, appeared as a representative of the Bell company before the executive committee of the People's Telephone association of Rochester to arrange for a settlement of the difficulty. The executive committee proposed rates to Colonel Parker to present to his company. After waiting some days for a reply and receiving none, the executive committee reconvened on the 26th ult. and rescinded all action taken on their part with a view of a compromise, and thus the matter now stands. Since then the Rochester *Morning Herald* has interviewed 101 business men of the 800 or 900 subscribers who formerly used the telephone and summarizes the results as follows: 58 do not want the telephone again, 28 would take it back and 15 are non-committal.

In equity it must be said that a toll rate in principle is fairer to both the company and the telephone user than a flat rate. But in the Rochester case the point turned upon the reasonableness of the proposed rates and upon this point the telephone users hung and declared the proposed rates were exorbitant. Then an association of subscribers was organized and the terms formulated upon which the telephone would be received again. Principal clauses in the list are that a flat rate shall be established and that that rate shall not be raised for five years from Jan. 1, 1888.

(*Continued from page 283.*)

magnetic circuit, the more force applied, the greater their resistance, and this holds good up to the point of the total annihilation of the magnetic circuit. This circle of equalized polarity is kept in an even magnetic condition either by the induction from the earth's forces or it can be made stronger and more intense by reinforcing it with small pieces of steel, or magnets, on the outside. This will give the watch escapement a medium to vibrate in where all the lines of force are exactly balanced and which will not be unbalanced by any ordinary outside magnetic condition. And further, the vibrations of the balance wheel are controlled to a certain extent by the lines of inter-etheric polarity, which exist in this medium within the circle, and is the steadying power or governor to rate the watch against. The conditions thus created makes the residual force which is in the watch a tangible, controllable influence, and makes it even and constant.

This tangible force, residing in the molecules of steel composing the balance wheel, is made visible in Fig. 4, representing a balance wheel within a shield cup, and the lines of force taken as developed with the cardboard and iron filings as in the other experiments. This sketch shows an outline of a watch movement within the shield circle, and the lines of force, or magnetic field, which surrounds the steel parts of the watch, the main spring, pinions, etc., and shows you the lines of force which the balance wheel cuts in its vibrations. This balance, [referring to a drawing not reproduced,] shows an unequal magnetization of its arms and circumference. The effect of this condition of the balance would be the same as running a watch with the balance out of poise, and is of frequent occurrence. This defect was discovered accidentally in searching for the cause of variation in a watch, which otherwise should run perfectly. To overcome the unequal magnetic condition in the balance and at the same time diffuse the controlling force through as nearly a perfect circle as possible, we have made and used a multipole balance where we have eight poles instead of two, as in the old balance. This is accomplished by using steel screws, instead of gold, in pairs. These pairs, taken in connection with the compensating circle of steel in the balance, gives us virtually eight small horseshoe magnets, which practically distribute the polar force in the complete circle of the balance, and when placed in the shield box gives us an almost perfect control of its movement, as far as the magnetic force is concerned. In order to distribute the polar condition evenly, through the balance, we first magnetize and then demagnetize it; this leaves the molecules of steel in an even "tonic" state. Utilizing the affinity of the steel in the balance for these lines of inter-etheric force we have the effect which horologists have sought so long in vain to accomplish; thus we use the great "arch enemy" of timekeepers to help us. We seize the subtle force which has been the "mischief-maker," and make it the means of perfection; in other words, we use magnetism to perfect the rate of the watch. The same force which has been the bane of horologists is the force which gives us the tangible, controlling power. The only stipulation made is, that the condition of magnetism in the watch, shall not be more intense than that of the surrounding circle or shield (it is better that it be much less, or at its medium). If it be more intense, it would interfere with the control of the lines of force, which we have established. The application of this controlling principle, to practical horology, must be of immense advantage. It gives us the key which will explain the mystery of the variations in the rate of time pieces, which horologists have searched in vain to discover. It will enable us to use in a "magnetic atmosphere" the very fine delicate steel compensations, and adjustments in watches, which have so nearly reached perfection and which have been found to be the only compensation that will stand the test of time, and hold its shape in a wide range of temperature. Substitutes for this steel compensation balance which have been tested by both governments and individual expert horologists within the past ten years have met with but indifferent success, and have been abandoned and rejected. Any immunity from magnetism obtained by non-magnetic material is at the sacrifice of the permanent accuracy of the watch when subjected to the wide range of temperature of our climate. With the discovery of the means of control of this force, magnetism is made a servant, a friend, "a very present help in trouble;" with it we can rate the watch with the regular compensation balance wheel much closer under magnetic conditions than we could one made of non-magnetic metal, even in the same temperature (leaving out the question of "heat and cold compensation"); because, first, in the steel of the balance, we have this tangible affinity for the lines of inter-etheric force existing in the medium inclosed in this circle of magnetic metal; secondly, having created conditions of force which we can control definitely, and intelligently; it gives us a steady force, or resistance, to run the watch against, and which acts as the governor of the vibrating balance or keeps the vibrations of the escapement in a medium of equal, constant conditions.

A watch deprived of this magnetic life—made of non-magnetic material—is an emasculated time-keeper.

The business part of the meeting of the Chicago Electric club, at which the foregoing paper was read, was quickly disposed of. Secretary Kreidler announced that with the applications for membership in hand the roll showed 182 names. Professor Badt, of the house committee of the club, announced that the furniture had been insured for $1,500.

After a vote of thanks had been tendered Mr. Giles for the paper, experiments were made showing the accuracy of the sketches used in illustration of the paper.

Professor Badt inquired if there were no other metals than steel which were non-magnetic, which could be used in place of steel in a compensation.

Mr. Giles said that all experiments in that direction had failed. A good compensation had been secured, but it had not been durable.

Mr. Bliss said he had seen an experiment tried with a Giles watch in an anti-magnetic shield where the watch was laid upon a dynamo and was stopped.

Mr. Giles said in regard to the effectiveness of the anti-magnetic shield, that it was designed for pocket use and was warranted to resist the effects of magnetism in that place or in any place except upon a dynamo.

Professor Badt said that he did not believe that there was any watch made that could not be stopped by placing it between the poles of a dynamo.

Mr. Stewart asked why a Waterbury watch was not affected by magnetism and Mr. Giles replied that it was because no steel was used in its construction. Mr. Bain and others took part in the desultory discussion that followed.

The next meeting will be held December 19th.

The Book Table.

STEAM ENGINE CATECHISM, by Robert Grimshaw, M. E.; Part 1; fifth edition, enlarged, 18mo, cloth, illustrated, $1.00; published by John Wiley & Sons, 15 Astor Place, New York.

This little book is unpretentious in name or in character. The design of the author has been to compile a series of direct practical answers to questions of like nature pertaining to the steam engine. It is is devoid of mathematical formulæ and admirably adapted to the wants of young engineers or, indeed, to older engineers who have not had the advantages of education or access to libraries containing technical information for which they feel a need.

The Edison Resistance Box.

To the Editor of WESTERN ELECTRICIAN:

PHILADELPHIA, DEC. 3.—(1.) What is the electrical term for the notches on a resistance box of Edison's make?

(2) How many 16 candle power lamps are controlled by each notch? J.

[(1.) We are not aware that a definite name has ever been given to them, although they are generally termed blocks.

(2) It could not be said that any one block controls a definite number of lamps as the gradations are so gradual that the movement of the hand slide contact over one block does not make a perceptible difference to the eye.]

Practical Telephony.

By THOS. D. LOCKWOOD.

PART II.

THE SIGNAL BELL:—One of the earliest offshoots of the articulating telephone itself is the call bell. We first employed in that capacity the key and sounder of the Morse telegraph, but soon found, not only that it was un-economical, but also that the call given by the sounder was adapted exclusively for the educated ear of the telegrapher. The battery bell, a simple electro-magnetic single stroke bell then was much used for a while, but for several reasons was never very popular, chiefly, however, on account of the dirty and unseemly battery, which was always an unpleasant accompaniment, and an unwelcome guest in the office or the home.

While I do not wish to obtrude my ideas on experienced telephone men, yet I may say that I believe the electro-magnetic battery bell, especially the vibratory type, to be well adapted to short isolated lines, and that the practical telephone manager should in all cases be ready to modify his practice to suit an individual case.

The battery bell is now generally superseded by the polarized bell, adapted to be operated by rapidly alternating impulses of electricity. Custom has given the title of "magneto bell" to the conglomerate aggregation of apparatus, comprised in the bell box, and including the bell proper, the generator and the switching devices. Properly speaking, the bell itself, the ringer, as we often style it, is no more a magneto than it is a battery bell. I made this statement once to a youthful aspirant to electrical honors in the telephonic field, and was greeted with the elegant and classical remark: "Oh, come now, what are you giving us?" To this gentleman and his prototypes, I respectfully reiterate the statement, and to others would say: Is it not so? What constitutes a magneto bell? Is there any difference between magneto electricity, so called, and voltaic electricity? Certainly none, in kind; and the difference in degree is only such as may be expected from differences in the character of the generator. This will be at once evident when we reflect that our bell can be equally well rung by a battery and polechanger, as by a magneto generator, and that such a thing is often done.

The bell, then, is a polarized bell; and although polarized bells are no novelty in electric signaling, the form invariably now used in telephony was not introduced until the telephone came into general use. To understand this bell, let the learner open the door or remove the cover of the bell box. He will find fastened to the upper part, a small permanent magnet, having its two ends bent at right angles to the middle part. An ordinary two spool electro-magnet is placed across one of the bent poles, and screwed to it, so that the other bent pole projects over the poles of the electro-magnet, but at some distance above it. A small soft iron armature of ordinary shape is pivoted by its center near to the second pole of the permanent magnet, so that its ends stretch over the two electro-magnet poles; and a stiff wire fixed to this armature and projecting outwardly carries the ball of metal which serves as the bell hammer. The two gongs of the bell are adjustably fixed on the outside or front of the bell box, and the hammer rod projecting through a hole in the front of the box allows the hammer to rest between the edges of the two gongs so that when it is operated, it plays between them, striking them alternately and producing the continuous ring we are so familiar with. In the best form of bell, the electro-magnet is attached to the upper or front pole of the permanent magnet, and the pivoted soft iron vibrating armature is affixed to the rear pole. It is found that bells so arranged are more sensitive and will ring through a greater resistance than others, because the pivoted armature being at the back of the box needs a longer bell hammer, and thus has a longer leverage, whereby a smaller movement of the armature is necessary in either direction to ring than in bells where the armature is pivoted in front.

Now let us see how such a bell works, and why

it needs reversed currents to operate it. The permanent magnet we have described has, of course, two poles of opposite character; it is customary to call one of these a north pole and the other a south pole, because in a compass needle one end points approximately to the north and the other to the south. However, it does not matter what we call them so that we fully realize that they have distinguishing features, and that like poles repel and unlike poles attract one another. For instance, if we take the so-called north pole of a bar magnet and present it to the north pole of a compass needle we shall see the needle retreat with every appearance of lively dissatisfaction. If we take the opposite course and present the north pole of the magnet to the south pole of the needle, we shall see that the attraction is now as marked as the repulsion was in the former case. The law of the mutual attraction of opposites seems inflexible and holds good in magnetism, for, just as surely as the alkali has an affinity for the acid, the positive electrical charge for the negative, the blonde for the brunette, or a railroad company for a mortgage, so the opposite poles of magnets have an affinity for one another.

By placing the electro-magnet on one of these poles and fastening it, we extend that pole and at the same time split it, so that supposing we have attached the electro-magnet to the north pole the polarity of the said pole is now passed along to the ends of the electro-magnet, and both cores of the electro-magnet are now north poles.

Similarly, when the soft iron vibrating armature is pivoted at or near the opposite pole of the permanent magnet, say the south pole, the magnetism of that pole is driven by magnetic induction to the two ends of the armature.

We now see that the two ends of the polarized armature, *i. e.*, the two south poles, are opposite to the two ends of the electro-magnet cores, which constitute the two north poles, and that the entire arrangement is thus in position to do work. But as the armature is pivoted, and has more or less travel or rock on its pivot, it lies a little towards the side to which it was last attracted.

When the bell is rung, either by sending battery currents rapidly reversed by means of a pole-changer, or by sending magnetic currents which, unless straightened by a commutator, are generated in a successively reversed condition, what ensues?

We have seen that the two soft iron cores of the electro-magnet become, when attached to the permanent magnet, inductively magnetized, with a polarity agreeing with that pole of the magnet to which they are fastened; and that the armature is similarly charged with magnetism of the opposite polarity; so that the armature, if held with both its ends at an equal distance from the cores, is attracted with equal force by each; but if we allow either end to swing over the veriest trifle, that end will be at once attracted to the corresponding pole. If a current of electricity be now sent through the coils of the electro-magnet, one of its two cores has its north magnetism weakened, neutralized or reversed, while the other has its north magnetism greatly strengthened, and this because the action of the current itself is to set up magnetism in the two coil-surrounded cores; in one leg of the magnet, north, and consequently agreeing with the normal polarity and reinforcing it, and in the other leg, south, and of course opposing the normal polarity and diminishing it.

Under these circumstances the armature which retains its normal polarity unchanged has one of its ends drawn strongly over to the stronger north pole of the electro-magnet, while its other end being no longer attracted—and if the core is reversed being actually repelled—exercises no opposing effect on and usually actively aids the movement.

The bell-hammer of course strikes the gong on the side to which it is attracted. This is the process which is requisite for a single stroke of the polarized bell. The next electrical pulsation is of opposite direction, and traverses the electro-magnet accordingly. The opposite core is now strengthened and the first one weakened, the armature flops over to the other side and the opposite bell is struck; and thus the two operations are repeated in the same way as long as the ringing is kept up.

If any student wishes to see for himself, in a leisurely way, the foregoing process, let him take an auxiliary polarized bell, or, as it is better known by that name, let us say an "extension magneto bell," two or three cells of any good battery, and a few four-feet lengths of office wire with the ends already bared; connect the several cells in series and fasten one of the wires to each battery pole. Now take the wire attached to the carbon or copper pole, unite it to one screw terminal of the bell, and with the other wire touch the remaining binding screw terminal. The armature and bell-hammer will be seen to come to one side, or if already there, to stay. Now reverse the connections, fasten the wire leading from the zinc pole, where the wire leading from the copper or carbon pole was previously, and touch the remaining screw-post with the carbon or copper connecting wire and the bell-hammer and armature will instantly fly over. It is well that the youngest engaged in telephonic work should understand the foregoing, and I have therefore been rather prolix in explanation. Beyond such an understanding there are very few points to be noted regarding the operation of the polarized bell in common use. If the armature sticks, the trouble is most likely one of two things, either the armature binds at the pivots or the permanent magnet has become demagnetized. Be sure what the trouble is before you undertake to remedy it, and then, in the first case, carefully loosen the pivots until free movement is secured; or, in the second case, take out the bell and have the magnet remagnetized.

If the bell makes a dull stroke it is most probable that the gongs are too close together; they may be adjusted a little further apart. If any subscriber makes a complaint that the bell is too loud for him, and it is thought that he will answer promptly with a less emphatic summons, one of the gongs may be unscrewed and taken away. If a broken wire is suspected, it can be ascertained and located by taking a LeClanché cell, a telephone receiver, and connecting them in circuit with a couple of wires, fasten one of the wires to one of the bell screw-posts and with the other wire commence to touch along the course of the circuit inside the bell box; so long as a click is heard in the telephone there is no broken wire between the two testing wires. As soon as any point is touched, and no click is heard, it becomes evident that a break is between that point and the point where the click was last heard, and by going carefully back it may be found.

There are other troubles which may occur, but which can be more intelligently considered after the entire bell box apparatus has been explained. They are therefore held in reserve, but will not be forgotten.

(*To be Continued.*)

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

NUMBER XXI.

Electric Units Continued.—The term "legal" is applied to the units adopted by the Paris conference to show that they are properly authorized, and to distinguish them from similar units previously in use. Hence the following are the practical legal electric units based on the C. G. S. system.

The Volt.—The unit of electromotive force is the volt, named after Volta the original inventor of the primary battery. It was originally derived from the Daniell battery cell, which notwithstanding its remarkable constancy represents a somewhat variable quantity; to give this unit a definite value 100,000,000 C. G. S. units were selected as the standard, which consequently represent the amount of electric energy which, if converted without loss, would equal this amount of mechanical force; but as large numbers are inconvenient to write, the equivalent expression, 10^8 has been adopted, and the same method of notation followed in regard to the other units. Hence, the legal volt equals 10^8 C. G. S. units of e. m. f. In approximate calculations, where strict accuracy is not required, the e. m. f. of the ordinary Daniell cell is still taken to represent the volt; its energy being about 1.05 volts.

The Ohm.—The unit of resistance is the ohm, named after Ohm who discovered and formulated the law of electric resistance. The resistance of a given number of feet of wire—copper, iron or German silver—of a given gauge was the original standard, but the Paris conference, acting upon the suggestion of Sir William Siemens, adopted as the standard a column of pure mercury, 106 centimeters in length and one square millimeter in cross section, at the temperature of 0° C. Its resistance is represented, to within a small fraction, by 10^9 C. G. S. units, the actual resistance represented by this expression being equal to that of a column of mercury of the same section and temperature, 106.21 centimeters in length; but to avoid the fraction the standard was fixed as above. The legal ohm then equals 10^9 C. G. S. units of resistance.

The Ampere.—The unit of current strength or volume, as has been explained, is the ampere, named after Ampere, who discovered and formulated the laws of electric currents. It is derived from the two preceding units in accordance with Ohm's law; current being equal to e. m. f. divided by resistance

$\left(C=\frac{E}{R}\right)$ hence since $\frac{10^8}{10^9}=10^{-1}=\frac{1}{10}$, the legal ampere equals 10^{-1} C. G. S. units of current strength. The element of time is not included in this unit, it refers exclusively to the volume or intensity of current commonly understood to represent its strength.

The Ampere Hour.—The ampere hour is a unit derives from the last, in which the element of time is included. It represents a current of one ampere flowing through a conductor for one hour, or its equivalent in a greater or less current for a greater or less time, as two amperes for half an hour, or half an ampere for two hours. It is of recent origin but is sanctioned by general use, and is very convenient in electric calculations.

The Coulomb.—The unit of current quantity considered with reference to time, is the coulomb, named after Coulomb to whom is due the first attempt at accuracy in electric science. It is derived from the ampere and represents the quantity of electricity which flows in a current of one ampere in one second. Hence any variation either in the time or strength of current produces a corresponding variation in the quantity represented in coulombs; a ten ampere current flowing for one second or a one ampere current flowing for ten seconds, represents ten coulombs; and since there are 3,600 seconds in an hour, 3,600 coulombs equal one ampere hour. The coulomb equals 10^{-1} C. G. S. units of quantity.

The Farad.—The electric unit of capacity is the farad, named after Faraday. It represents the storage of one coulomb of electricity in a condenser; and when such storage raises the potential to one volt, the condenser is said to be of one farad capacity. The farad equals 10^{-9} C. G. S. units of capacity.

The Microfarad.—The farad being inconveniently large for practical use in the construction of condensers, the microfarad, representing one millionth of a farad, has been adopted in its stead. Hence the microfarad equals 10^{-15} C. G. S. units of capacity.

The Watt.—The unit of electric power is the watt, named after Watt the inventor of the steam engine. It is derived from electromotive force and current combined, neither of which taken alone is an exact representative of electric power, since current is derived from resistance and e. m. f., either of which may vary, producing a variation of current; or one may vary inversely as the other, producing a constancy of current; hence, to obtain an accurate expression for electric power, or rate of work, the e. m. f. is multiplied into the current, that is the volt into the ampere. A watt then equals one volt multiplied into one ampere, which equals 10^7 C. G. S. units of power ($10^8 \times 10^{-1}=10^7$). The term volt-ampere is synonymous with watt.

The Electric Horse Power.— The electric horse power which is the equivalent of the mechanical horse power, is represented by 746 watts, equal to $746 \times 10^7=7{,}460{,}000{,}000$ C. G. S. units of power.

The Joule.—The electric unit of heat is the joule, named after Joule who discovered and

formulated the law by which the electric current develops heat. It represents the heat developed in a conductor by one watt in one second; it also represents the work done by a watt in a second, its relation to the watt being similar to that of the coulomb to the ampere, since it includes the element of time. Its equivalent in work is represented by 10^7 C. G. S. units.

Prefixes are used to denote either multiples or fractions of units. Megohm denotes one million ohms, milliampere one-thousandth of an ampere, and microfarad one-millionth of a farad, as already stated.

The Bernardos and Olszewsky Welding Apparatus.

Extensive experiments with the electric welding apparatus of Nicholas de Bernardos and Stanislas Olszewsky of St. Petersburg, have lately been made in Tegel, near Berlin, Germany. The process is described as follows: The joint of the two metals which are to be welded together is connected with the negative pole of a dynamo or other source of supply, the positive pole of which is formed by a carbon pencil. Under the heat of the arc the two metals are melted at their junction and fused together, the carbon being handled very much in the same way as a blow pipe. It is necessary that the current should pass from the carbon to the metals, as otherwise the latter would be volatilized. The metals do not oxidize, but through the presence of the carbon a slight reduction takes place. In this manner it is possible to join copper and iron, or steel and iron, or any two similar or dissimilar metals. The slightness of the chemical change produced by the action of the arc at the joint is shown by the appended table:

	Steel.		Iron.	
Composition of Material.	Before Welding.	After Welding.	Before Welding.	After Welding.
Carbon	.48	.25	.34	.14
Silicon	.04	—	—	—
Manganese	.50	.25	.50	.23
Sulphur	.04	.04	.14	.09
Phosphorus	.08	.07	.12	.11
Iron	98.86	99.30	98.90	99.43

It is necessary to carefully adjust the current to the work in hand, for if the current be too large, a portion of the metals is volatilized, and if too small, fusion does not take place because the heat has time to flow away through the body of the metals. This adjustment is provided for by the use of secondary batteries and a suitable regulating switch to vary the number of cells in circuit. In the laboratory above mentioned, there is installed a dynamo giving 120 amperes and 175 volts, which is used for charging 280 accumulators grouped in four parallels. The plates of these cells are constructed in a similar manner to the Khotinsky accumulator, which made a brief appearance and then vanished again some few years ago. They consist of a lead frame, serving as a support for thin lead tapes alternately corrugated and straight, placed side by side within the frame. Since the dynamo is always kept running, storage capacity is not of so great importance in this process as the ability of the cells to discharge very large currents for a short time. The inventors employed at first E.P.S. cells, but finding that their greatest merit which consists in large storage capacity, was not of much use in this particular application, they reverted to the type above described, which more nearly approaches the original Planté cell. Owing to the reducing action of the carbon, it is possible to weld metals even if they be coated with a slight layer of oxide, and in no case is any cleaning of the joints necessary. To give an approximate idea of the energy required in this process, it might be mentioned that during the experiments above cited a lap joint between iron sheets of 2 mm. thick was welded with a current of 15 amperes supplied at 65 volts pressure. Thin lead sheets can be welded by the use of from two to five cells, the carbon pencil in this case being 5 mm. diameter. It is also possible to perforate metal plates by the arc, the carbon pencil being simply pushed through the plate as fast as the metal melts, and the writer in *Industries* has seen a lap joint of two ⅜ inch boiler plates, in all ¾ inch of metal, thus perforated. It is remarkable that the perforation can also be carried on under water.

CORRESPONDENCE.

Eastern Notes.

New York, Dec. 4.—Of interest in the telegraph field this week is the change of tariff which went into effect Thursday, and which the company designates as "extensive reductions." The maximum rates west of the Mississippi are reduced from one dollar to seventy-five cents, and east of the Mississippi from seventy-five and sixty cents to fifty cents, for ten words. This is simply a reduction on its own advance over its old competitive rates, as everyone knows who has to pay telegraph bills, and for this reason the great corporation gets little credit for such concessions, and the anti-monopoly press hastens to impugn its motives and accuse it of trying to hoodwink the public.

Rates as at present are profitable and there are rumors of new rivals to enter the field. The secretary of state of Massachusetts, has been petitioned from Boston for the incorporation of the Postal Automatic Telegraph company with the object of building a line across the continent from New York to San Francisco; the capital stock to be $3,000,000 with authority to increase to $20,000,000.

In the New York stock exchange the telegraph companies have heretofore paid a rental of $9,000 a year for the six compartments they occupy, and, in addition, a toll of one cent upon each message received and delivered. As soon as they began to work in harmony they notified the stock exchange committee that on and after the first of December they would not pay more than $1,000 a year rental for each compartment and that at the same time they would insist upon the entire abolition of all tolls upon messages. The committee of arrangements offered to compromise by a partial reduction in charges, but the representatives of the telegraph companies refused to accept any compromise and threatened to take out their instruments at once and shut the exchange off from all telegraphic communication. This threat was not carried out, but the matter is still in dispute and the telegraph companies would seem to be in shape to enforce their demand.

The Western Union company is making a strong fight in the courts against the tax of $10,618 assessed in May, 1885, on the corporate franchise of the company doing business in the state of Massachusetts. In the United States circuit court in Boston on the 28th ultimo, Judge Colt decided against the company, but they have taken an appeal to the United States supreme court. Much more than the amount named is involved, as the company are at issue with other states upon substantially the same question.

The commissioner of patents is hearing arguments upon the petition of Elisha Gray to amend the original application for his telephone patent by inserting therein the word "metallic" so as to make the claim specifically for a metallic diaphragm. The hearing will probably occupy several days, and, should the motion be granted it will result in the reopening of the interference case of Gray vs. Bell. The great interest taken in an opposition telephone, and the demand for such a thing if it may be had, are illustrated by the effect of the advertisement in the columns of the Western Electrician of the American Cushman Telephone Co. Cushman instruments are not so plenty in the east as in the west, and the experience of your correspondent is that as soon as people find that an electric telephone is boldly offered for sale they want to know all about it.

The Schuyler Electric Light company, have been very much inconvenienced in their business by the burning of their factory at Newark this week. The total loss to the company is about $2,500 and arrangements have been made with other companies to carry out their contracts.

At Philadelphia Martin Doherty has entered suit against the Brush Electric Light company for $20,000 damages. He was an employe of the company and was severely shocked and burned by coming in contact with a grounded wire while working on a pole last August.

Considerable opposition has been developed in respect to the ordinance permitting the Bell Telephone company to put their wires under ground, as it is held in some quarters that the subways in the streets should be built and owned by the city. The meeting held day before yesterday adjourned without final action, but it is expected a favorable decision will be reached, as the city is in no condition financially to contract for expensive subways. The Bell Telephone company are ready and anxious to take hold of the work, and they have abundant means.

The South Brooklyn Street Railway company expect to use electric motors on their lines to New Utrecht.

The Daft Motor company will soon renew experiments in New York on the Ninth Avenue elevated road. The motor they will use will have a capacity of 125 horse power, and is expected to draw five loaded cars with ease.

In the course of a week or two the Sixth Avenue surface road will begin running a car operated by storage batteries, and if successful, others will be added as fast as possible.

Even the stages are looking for better light. Experiments have been tried this week in one of those that run on Fifth Avenue, a storage battery weighing 132 pounds being used to operate two lights of 6 candles each. The results were favorable and President Goddard says that if entirely successful he will place such an outfit in each stage.

The telegraph operators employed by the elevated railroad are dissatisfied and talking of striking because they are required to teach gatemen the art of telegraphy. They claim that they have to work long hours each day, and for seven days in the week, for $2.25 per day, and that they believe the railroad company wants to reduce their wages still further, and in case of a strike, to set the gatemen at telegraphing.

The board of police commissioners are carefully investigating the merits of the different police signal systems, and when they make their decision they propose that New York shall have the finest and most complete outfit in the world. Some half a dozen different systems are now in practical operation in the Nineteenth precinct, and the commissioners are devoting a day or half a day to the consideration of each. A.

Philadelphia News.

Philadelphia, Pa., Dec. 3.—In electric matters things may be said to be booming. All through the business portion of the city, the streets have been torn up by the various telegraph, telephone and electric light companies for the purpose of burying the wires, and as the law does not allow the streets to be torn up after Dec. 1st, large gangs of men have been put to work to rush things through to completion.

The Pennsylvania Railroad company's ferry boat, plying between this city and Camden, N. J., was recently lighted by the Westinghouse company by electricity. This means of lighting has proved so satisfactory that the same road have given an order to the Westinghouse company to light all their ferry boats running on the Delaware river.

The post-office is being lighted by electricity by the United States Electric Light company of New York, at a cost of from sixty to seventy thousand dollars.

The Electric Car company of America recently gave an exhibition of their new street car which is run by Reckenzaun electric motors.

Professor Edgerton expects to have his electric motor street car make its trial trip the fore part of next week, and great results are looked for. All of our electrical supply people are full of business with orders away ahead.

At a special session of the Board of Highway Supervisors held recently, a report was submitted by Chief Walker of the electrical, Park of the gas and Ogden of the water departments, approving the proposition of the Penn Electric company to lay modified forms of conduits on several streets.

The Edison and the Penn companies are putting down underground wires in the same trench. The Edison people are putting down two iron pipes, containing several conductors and filling them with pitch. The Penn company are putting their wires in wooden conduits on top of the two iron pipes put down by the Edison people, and the Edison company have put two other iron pipes with conductors on the top of this wooden conduit. The Keystone Light & Pow-

er company have asked the council for permits to place more electric wires underground.

The Edison Electric Light company will shortly begin the work of tearing down the five dwellings on the south side of Sansom street, west of Ninth, preparatory to the erection of a substantial six-story building for the uses of the company. The lot is 70x100 feet and the new building, which will be solidly built of brick, will entirely cover it. The following are the uses to which the different floors of the new building will be put; in the basement will be located eighteen engines with a combined horse power of 3,600. The first floor will contain 36 dynamos; the second floor will be the ash floor; in the third story will be placed the boilers; the fourth floor will be used for coal storage, and on the fifth floor will be placed the offices. It is expected to have the building ready for occupancy early in the spring.

John A. Grier of West Philadelphia, is temporarily located at North Adams, Mass., in charge of the undertaking of illuminating the Hoosac tunnel with 1,250 twenty-five candle power incandescent lamps, of the Westinghouse system. This is a Pennsylvania venture to light what may certainly be called the darkest hole in New England.

The Thomson-Houston company of this city have closed a contract with the Thomson-Houston company of Baltimore for a 200 light plant. They have also contracted with the Mahanoy City Electric Light company for 50 lights and with the Conshohocken Electric Light company for a small plant. They have started to install a 70 electric light plant for the Adams Express company, at their station, Sixteenth and Market streets, and are about completing arrangements with a neighboring arc plant to increase their plant by the addition of 1,300 incandescent lights on the alternating system.

M. R. Muckle, jr., of this city, will put in a 50 horse power Westinghouse engine and two 50 horse power boilers to furnish heat, run the hoisting machinery and the electric lights for the Adams Express company at Sixteenth and Market streets. They will also put in a 25 horse power engine for the purpose of lighting the same company's stable on Twenty-second street, between Market and Chestnut.

The Cleverly Electric works, 1018 Chestnut street are very busy on general electric supplies, so much so, that they have found it necessary to take two extra rooms. In automatic burners, electric candles, electric clocks and electric bells they are particularly busy and consider the prospects very encouraging. J.

From The Pacific Slope.

San Francisco, Nov. 25.—The electric lights on high towers, at Santa Barbara, can be seen 60 miles up and down the coast. Although this plant is the youngest in the state, it has 105 lights of the Thomson-Houston system and the prospects are for an immediate increase.

Arlington hotel at this place is about to put in a Thomson-Houston Incandescent plant.

The Board of Supervisors of San Francisco have awakened from their long sleep and ordered electric lights put in all the parks and squares throughout the city, so as to put a stop to park crimes.

Frank Jaynes, superintendent of the Western Union company, has had a leave of absence for six months granted him.

The West Coast Electric company have purchased a Thomson-Houston incandescent plant as an exhibition plant for their use.

S. H. Taylor, agent of the Thomson-Houston company on this coast, is on a trip south.

H. Swayne & Co. have been granted a franchise for an extension of their electric railroad.

At San Jose attempts are being made to get the electric road down from that place to Santa Cruz before the winter rains set in. On the main streets the tracks and conduits are laid and the road is being pushed to Alum Rock and the cemeteries.

Miss Annie Dixon, chief operator at the San Jose telephone and fire alarm station, reports business rushing and says that the office is too small for the amount of business being done. New switch boards and office fixtures have been ordered.

Paul Sieler, superintendent and electrician of the California Electrical works, is contemplating an eastern trip. Mr. Sieler is a veteran in electrical service, and is the oldest superintendent on the Pacific Slope.

Redding, Cal., is to have a Thomson-Houston plant.

A large amount of motor work is being done in California, Oregon, Nevada and Washington Territory.

The Southern Pacific railway will light their mole with an isolated plant of the Pacific Coast Electric company system. Mr. Statler, electrician and superintendent of the railroad block system, says that they will move their dynamo, engines, boiler and air compresser upon dry land, and increase the capacity of their lighting plant. He is preparing plans for lighting the company's ferry-boats with the incandescendent light and instead of using oil in the block signals he will use incandescendent lamps. The company have the Brush system in use.

A project has been advanced to tap lake Tahoe by a huge siphon. It is believed that 100,000 horse power can be realized from the fall, and that the tail water can be utilized for irrigating purposes. The power will be distributed where needed through the medium of electricity.

R. A. Simon will leave about December 1st on his customary winter trip to Washington Territory, Oregon and British Columbia.

President Burt of the San Bernardino Electric Light & Power company was here last week looking for 500 electric light poles which are scarce now as the saw mills are full of other work. For the benefit of those interested in the price of sawed red wood poles the following list is given:

18 ft. poles, 8x4 in	$ 1 25
22 ft. poles, 8x5 in	1 40
25 ft. poles, 8x5 in	1 75
30 ft. poles, 10x6 in	3 50
40 ft. poles, 12x7 in	6 00
50 ft. poles, 14x8 in	15 00
60 ft. round masts, 18 cents per ft.	10 80

The Electric Development company have moved into their new quarters in the Telephone building and fitted their office throughout with Edison apparatus, storage batteries and Western Electric supplies. The Pacific Electrical Storage company are in the same building. J. C. Henderson is manager of both companies. He reports that the new factory for manufacturing storage batteries, electric motors and cars is almost ready for occupancy. The factory is at the corner of Sixth and Townsend streets, this city.

It is alleged that H. Weske, president of the Pacific Coast Electrical company, has had Mr. Blair, their collector arrested for trying to cash a $6,500 note made by Weske. Blair claims that Weske gave it to him for his services rendered in trying to obtain a franchise from the Oakland council and to keep a certain person from closing down on a mortgage on their works.

An Oakland, Cal., paper definitely states that "the Pacific Coast Electrical Construction company, with works at Webster and Second streets, has become the property of the Oakland Electrical Light & Motor company, a company recently formed by Oakland capitalists for the purpose of acquring the property. James Gamble is the president of the company, Thomas Corder vice president, and W. W. Blow, secretary. For the immediate present the business will be conducted under the old name. A second issue of stock will be made, with the procceds of which to purchase new machinery." S.

Indianapolis Items.

Indianapolis, Dec. 4.—An important suit has been brought and is now being argued before Judge Gresham of the United States court in this city. The Brush Electric company of Cleveland seek to enjoin Owen, Pixley & Co., proprietors of a large clothing house here, from using their present system of electric lighting and for damages for past use. The system in use is that of the Fort Wayne Jenney Electric company, and has been in use for the past four or five years by defendants for lighting their immense establishment. It is alleged by the Brush people that the Jenney system is an infringement on their patent. L. L. Leggett of Cleveland opened the argument in the interest of the Brush company. R. S. Taylor of Fort Wayne appears for the defense. The latter gentleman is said to be one of the best posted men in electrical appliances in the country. The court room looks like an electrician's experimental laboratory, as electrical machinery and lamps of all kinds are on exhibition there for use in the case.

The Jenney Electric company of Indianapolis are wiring the Indianapolis Car works preparatory to putting in a plant. They have also closed a contract with Kingan & Co., pork packers, for a 1,250 light incandescent plant.

The Western Union Telegraph company here have been troubled somewhat lately from a heavy current on one of their wires running from Indianapolis to Evansville. About a week ago their switch board at Terre Haute was burned out early in the morning. The next morning the Indianapolis switch board was discovered on fire from the same cause, but the wire was disconnected before any damage was done. It was supposed to have been crossed with an electric light wire, but a thorough tracing fails to show any such wire near it, and the cause still remains a mystery. M.

Detroit's Budget.

Detroit, Dec. 3.—The Detroit Electric Tower company has begun two suits in the United States court against the cities of Ypsilanti and Bay City to restrain them from using the patent by which electric light towers are mounted on one leg, as in Detroit. The company alleges that it paid John S. Adams for the right to use the patent for five years. Three years later it secured another patent from Adams, thus securing the exclusive right to his inventions, which right the court has affirmed.

Acting upon the findings of the committee, appointed to investigate the practicability of an underground system, the common council has passed a resolution directing that all poles and wires within a radius of one mile of the city hall be removed on or before July 1, 1888. The various companies have been served with official copies of the resolution.

The Brush company has been awarded the contract for lighting the city for three years. The price per year is $117,940. It is thought that the mayor will again veto this award, he being strongly inclined to the opinion that the city can do its own lighting much cheaper; in fact, light all the streets and public buildings as at present for $50,000 per annum. As the resolution awarding the contract, was passed by a vote of 20 to 10, the mayor's veto would probably not be sustained.

The Swift Electric Light company of Bay City has given notice to its patrons, that after December 1st it will cease to do commercial lighting, being unable to carry on the limited business at a profit. The company has also gone out of business in West Bay City. The latter place will be taken care of by the home company, using the Thomson–Houston system.

The Edison, and Thomson–Houston companies, at Ann Arbor, have consolidated. C.

THE ELECTRIC LIGHT.

The Chicago and Northwestern Railway shops at Chicago are wired on the Edison three-wire system.

Arkansas City, Kan., expects to beam forth soon with the electric light.

The Pullman Palace Car company, at Pullman, Ill., has been busy for the past two months establishing a system of electric lights by which all of the various departments can be lighted sufficiently to allow the workmen to work at night as well as in the daytime. The system has just been completed, and is one of the largest and most complete electric plants in the country.

The contract for the building to be erected by the Salina, Kan., Electric Light & Power company, has been let to W. F. Gilbert, and work has already been begun. The company has contracted for upwards of 900 incandescent lights.

Thomas Conroy, engineer of the electric light wires at Marion, Kan., had his thumb so badly mangled while working about the engine that immediate amputation was necessary.

Recently a malevolent scamp entered the Thomson-Houston electric light station in Wichita, Kan., and ruined one dynamo and seriously damaged two others.

The new Edison lamp is in use at Pullman, in the Northwestern's shops at Chicago, at Crane Bros., Chicago, and in the People's theater in Minneapolis. The lamp is guaranteed at twelve to the horse power at the dynamo pulley, and its lifetime is guaranteed to be the same as the old lamp, that is, 600 hours. The new lamps take less than half an ampere.

The temporary installation of a storage battery at the Calumet club in Chicago, worked very satisfactorily. The capacity of the Edison dynamo was about 175 lights, while the total number of lights desired during the art exhibition was about 210—160 in the club and 50 in the house. One hundred and ten cells of Julien accumulators were put in, and the combined capacity of dynamo and storage battery was more than sufficient to supply all the lights.

Electric lighting of trains receives appreciative attention in Canada. The first train in the Dominion so lighted is regularly running between Montreal and Ottawa. A Pullman drawing-room car, one first-class car, and one second class, are fitted with incandescent lamps and Julien storage batteries. There are 19 lamps in each of the two former cars and 13 in the latter. When arrangements are completed trains will run from Halifax and St. John to Quebec and Montreal, lighted by electricity and heated by steam. The batteries will be removed from the cars for charging, which will be done at Halifax, Moncton, St. John, Point Levi and Montreal. It is reported that the Canadian government has appropriated for electric lighting and steam heating on the Intercolonial the sum of $24,500, and that road is actively at work equipping two trains with Julien storage batteries.

The experiments with the incandescent electric lights which have been made at the torpedo station at Newport have developed a novel use for the little lamps, and one that is said to promise to be of great value in naval warfare. With lamps of about 100-candle power fastened on the ends of poles submerged in the sea to a depth of twenty feet, the water is so illuminated that objects in it can be distinguished within a radius of 150 feet. There is little or no glare from the submerged light to betray the presence of the boat using the spars. It is believed that by this means a boat might countermine an enemy's field of submarine mines by cutting their cables or sweeping them to one side. It is probable that torpedo launches will be equipped with these lights in future.

The Jenney Electric Light company are putting a plant into Holton, Kan.

At a meeting of the directors of the Salina, Kan., Electric Light & Power company, held the 13th ult., the following officers were elected for the ensuing year: President, J. F. Burrows; vice-president, George Krueger; secretary, W. R. Geis; treasurer, W. F. Gilbert.

The city council of Marion, Kan., have contracted with the local electric light company for fifteen lights.

Sault Ste. Marie is to have an ice rink 50 by 200 feet in size under cover, and lighted by electricity.

There is probably not a town of 5,400 people in the state which has not an electric light plant, says a Kansas paper.

The steam yacht Thetis has recently been fitted with a complete installation of the electric light by Muir, Mavor & Coalson, of Glasgow. About one hundred lights are fitted throughout the yacht, electric lamps being used in the masthead and side signal lamps, and in the anchor lamp. The wiring is divided into five circuits, controlled from the upper platform of the engine room, where the switch-board and measuring instruments are fixed. Double pole fuses are fixed on the switch-board for each circuit, and from these fuses the cables are led directly to five distributing boxes in various parts of the yacht. All the branch wires converge from the lamps to these boxes, and are connected to the cables through double pole fuses. The distributing box for the lamps in the machinery space is fixed in the engine room, and is of cast brass, perfectly water tight; all wires in engine and boiler rooms are sheathed with lead. An accumulator with a capacity of 600 ampere hours is fixed in the engine room near the generating plant. The boxes, which are of metal alloy, are arranged in three tiers up the yacht's side. They are set upon glass insulators, and each cell is separately secured in place by a system of levers and screws completely insulated by glass insulaters. The generating plant consists of a Willans central valve compound engine coupled direct to a Siemens dynamo, which is wound to give 120 amperes at 65 volts as a simple shunt, and at 50 volts as a compound machine at a speed of 400 revolutions per minute.

THE ELECTRIC MOTOR.

The Rockford Electric Power company, at Rockford, Ill., has been incorporated. The capital stock is $30,000 and the object is the generation and transmission of power by electricity; incorporators, John Bartlett, J. W. Bartlett and Albert L. Bartlett.

It is announced that the Emperor of Brazil is going to order a circular electric tramway for his own personal use on the lines of the society of tramways at Rio Janeiro. The motor is of the Sprague system and will be fed by accumulators.

Charles G. Curtis and Francis B. Crocker, two electricians of New York, have for a year or more been giving their attention to the problem of aerial navigation. They believe they have perfected an electrical contrivance that will enable them to control the direction of a captive balloon in motion. The motive power and steering apparatus consist of a fan, from five to ten feet in diameter, with a wide blade of thin steel. The fan is to work horizontally, deriving its power from the electric motor suspended just below the center or hub of the lowest side wheel. Below the motor and fan the car will be suspended. The motor is to weigh not more than 200 pounds and will have the force of a ten horse power engine. The fan will ordinarily make 1,500 revolutions per minute, but can be increased to 3,000 or even 5,000 revolutions in case of an emergency. The steel blade, acting against the air at such speed, will be sufficient to carry the machine upward and to steer it with or against a current of air by deflections of the fan. The new flying-machine is not, however, a free agent, but must remain captive, connected by wire with a dynamo, which will furnish power to the motor. Up to the present time no storage system or primary battery has been discovered of sufficient power or lightness to be carried by the machine itself. Mr. Crocker is deeply interested in his invention, but he admits that it will be of no practical utility, except for war purposes or weather observations. He hopes to have the machine perfected in time for exhibition at the Paris exposition.

Immisch & Co., of Kentish Town, London, recently made some tests of a pump in a colliery at Normanton, driven by a motor. Current is supplied by a dynamo on the surface, which is driven by a steam engine 14 inch cylinder by 15 inch stroke. The current from the dynamo is led down the shaft by insulated cables, and works an Immisch motor at the bottom of the pit, which drives a pair of differential plunger pumps. The plungers are 6 inches and 4½ inches in diameter, and two pumps are driven from a shaft with cranks at right angles. Owing to the differential arrangement of plungers the suction of each pump is single acting, but the delivery is double acting, and equivalent to that of a piston 4½ inches in diameter. The total lift is 530 feet, and the quantity of water raised during the trial was 39 gallons per minute, corresponding to a useful effect of 6.26 horse power in water lifted. The connection between the motor, which runs at 650 revolutions per minute, and the pump, which makes only 8 revolutions a minute, is by means of a transmission in three stages—first, by a 10 inch cotton belt from the pulley of the motor to a large pulley on an intermediate shaft; the second by a mortised pinion gearing into a cast iron wheel; and the third by a pinion on the shaft of this wheel to a wheel on the crank shaft of the pump. When doing full work the engine indicated 14.3 horse power, the output of the dynamo being 47.5 amperes, at an average pressure of 172 volts, corresponding to about 11 electrical horse power. The resistance of the leads is .29 ohms, producing a loss of .88 horse power, so that the motor at the bottom of the shaft is supplied with 10.12 electrical horse power.

THE TELEPHONE.

The London *Times* announces that the Chinese government has refused to ratify the agreement between Li Hung Chang and an American syndicate formed for establishing telegraph and telephone lines in China.

The telephone line between Beatrice and Fairbury, Neb., is now an assured fact. A force of men has already been set to work upon it, and it will be completed and ready for use by January next.

The telephonic system of the Victoria company at Melbourne has been purchased by the government for one million francs.

The military authorities of camp Aldershot in England, have installed a military telephone system in the camp. They hope by this means to be able to return to their respective regiments a great number of men now employed as orderlies, by obtaining a means of communication much more rapid between the different branches of the service.

Incorporated in the annual report of Julius Vogel, postmaster general and electric telegraph commissioner of New Zealand, for the year closing March 31st, 1887, and just received, is a report by C. Lemon, superintendent of posts and telegraphs of much interest. March 31st, 163 offices were connected by telephone, an increase of 29 offices over the number for the preceding year; the number of offices both telegraph and telephone open at the end of the year was 406 against 375 the preceding year. There are now eleven telephone exchanges and two branch exchanges one of which, at Blenheim, was opened the first of last April with 38 subscribers. Following is a list of the exchanges with the number of subscribers to each: Auckland 425, Napier 94, Wanganui 113, Wellington 366, Nelson 71, Christchurch 299, Timaru 62, Oamaru 47, Dunedin 500, Invercargill 65, a total of 2,042 and an increase of 287 subscribers for eleven months. The capital expended on the telephone exchanges amounted on the 31st of March to £44,566. The gross revenue for the year was £15,477. The working expenses amounted to £9,806, and the net revenue of profit was approximately £5,671.

THE TELEGRAPH.

The Chicago Postal Telegraph company; capital stock, $500,000, incorporators, Marcus Polasky, George L. Miller, and William S. Robbins, is one of the recently incorporated companies.

A cablegram from London dated the 4th states that the negotiations between England and France, contemplating the joint working by the two governments of a telegraph system across the British channel, promise to conclude amicably and satisfactorily to both parties. France has joined England in refusing to renew the present concessions enjoyed by the Submarine Telegraph company, and the latter being completely shut out will be obliged to sell its wires, etc., upon the terms set by England. The British government is disposed to reduce the rate by the submarine lines to 2d per word, and with this rate France is believed to be satisfied.

The telegraph wires at different points in Ireland having been cut malevolently several times and recently between Kilrush and Ennis, the local police have announced to the inhabitants that in future a guard of police will be installed at the place where the wires shall have been cut, at the expense of the parish where the act shall have taken place.

A Washington dispatch quotes Assistant Postmaster-general Knott as saying that he is convinced that the goverment will establish a system of postal telegraphy within three years.

The Canadian Pacific Railroad Telegraph company's circuit manager at Newminster recently wired to Manager Hosmer, at Montreal, that the wires at Griffin lake and Revelstake had been crossed by bears climbing the poles. The tracks around the poles and the nail prints in the poles were apparent. Bear traps were accordingly placed at the foot of the poles.

Two freight trains on the Wheeling division of the Baltimore & Ohio railroad collided near Cochrane's Mills, fifteen miles from Pittsburgh, Pa., on the 25th, ult. The collision is said to be due to the negligence of a woman telegraph operator, twenty-four years of age, in failing to deliver an order.

Telegraphic communication will shortly commence between Russia and France. All dispatches at present come through Germany, and have recently been tampered with at Berlin. Russia in the case of war between Germany and Austria, would be entirely cut off from telegraphic communication with the remainder of Europe.

Miscellaneous Notes.

Conrad Steinel, a young electrician at the Western Union office in St. Joseph, Mo., lights the gas jet over his desk by electricity. He has a new method of his own invention, which may, in the course of events, be used in lighting street and other lamps.

A fortnight ago Wilkesbarre, Penn., was thoroughly shaken by the explosion of a box containing several pounds of dynamite which was being used in an excavation. The electric wire used in exploding the dynamite got in its work before intended.

Levy, the inimitable cornetist, has found a rival in the graphophone. He stood beside the apparatus in Washington recently and filled the air with such variations of "Robin Adair," "Yankee Doodle," "Killarney" and the "Last Rose of Summer" as only he can roll forth from the cornet. When he had concluded the recorder of the graphophone was removed and the reproducer substituted. The cylinder revolved and the little needle began to follow the influential track that had been carved upon the wax. A little fainter than the original playing, but preserving all the sweetness and the clearness of the cornet's notes, the graphophone began to repeat the tune of "Robin Adair." Then it rattled merrily the variations of "Yankee Doodle," while the notes of the "Last Rose of Summer," and "Killarney" were perfectly reproduced. More songs were played, and no matter how many twists and turns the cornetist gave to his notes he found that the graphophone recorded them all with marvelous minuteness and distinctness. Levy had played into the phonograph, but, as he remarked, that machine gave a metallic and harsh reproduction, failing entirely to preserve the delicate phrasing and the clear, bell-like tone which characterized his playing. After the music there was some conversation. "It's the most wonderful and astonishing thing I ever saw in my life," said Mr. Levy, and "It's the most wonderful and astonishing thing I ever saw in my life," echoed the graphophone, as it impudently repeated, also, a little cough to which Mr. Levy had given utterance. Finally the cornetist turned to depart. "Good-by," said Mr. Levy. "Good-by," replied the graphophone.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	390
Central Union	44	45
Michigan	76	77
Great Southern	30	32
Colorado	18	20
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo	160	165
Iowa Union	28	30
Missouri and Kansas	68	69

Personal Paragraphs.

W. H. Boulton, superintendent of the Standard Carbon company of Cleveland, O., was in Chicago the early part of the week.

W. W. Griscom, managing electrician of the Electrical Accumulator company of New York, was in Chicago Monday last.

November 28th, at Minneapolis, Dr. Sylvanus D. Cushman, of the American Cushman Telephone company, was united in marriage to Mrs. Idella M. Burghiem. To the rest and happiness of a home the doctor is surely entitled. In his prolonged litigation with his great competitor he has been tireless in collecting evidence, and has been practically homeless. Congratulations and hearty wishes for happiness will be offered by the many friends of the doctor and his estimable wife.

W. J. Johnston, of the *Electrical World* of New York, was welcomed as a guest of the Chicago Electric Club last Monday evening.

Business Mention.

Leonard & Izard, 185 Dearborn street, Chicago, are now general agents for the Edison United Manufacturing company and also agents for the Chicago Edison company for isolated plants in Cook county. They are about to establish a supply depot in Chicago for Edison apparatus.

"The universal condemnation of the so-called underwriters wire, and the demand for somethig better, has induced us to offer our new Trinidad line wire," write the Callender Insulating & Waterproofing company, "as a substitute for its use, and at a very little higher price. This wire is served with two coatings of our bituminized tape and braided over all. A serving of Trinidad compound is put on between each tape and braid. The outside finish is neat, clean and strong. It will not liquefy, nor become sticky with heat nor brittle with cold. The covering is tough and tenacious, will stand rough usage and a rubbing contact without abrasion. While we claim that this wire is a water proof line wire, we do not claim that it should be used in wet places and in permanent contact with iron; in such places our Bitite insulated wires should be used. We claim that our Trinidad line wire is well insulated, and is the cheapest, and most serviceable wire offered for all pole work, especially for high tension current."

Leonard & Izard have contracted with the Kearney Milling company at Kearney, Kan., for an Edison plant of forty lights; with Selz, Schwab & Co., of Chicago, for a plant of 600 lights, and will extend the system at the Soldiers Home in Milwaukee.

The Waterhouse Electric & Manufacturing Co., of Hartford, Conn., represented in Chicago by C. F. Dunderdale, have taken the following contracts recently: Ashland Electric Light & Power Co., of Ashland Ky., a 30 full arc light plant for city lighting and a 30 arc light plant, each light of 1,400 candle power, for commercial lighting, to be in operation by January 1st; a 20 light plant for the Horse's Home at Chebanse, Ill., Leroy Payne, Palmer House livery, Chicago, proprietor. The Citizens Electric Light Co., of Wellsville, Ohio, have just started a 100 light plant of this system.

W. J. Buckley, Chicago manager for the Fort Wayne Jenney company, has recently taken a contract for 1,000 incandescent lights at Salina, Kan., and 600 incandescent lights for the Armour Packing Co., at Kansas City, Mo.

The Western Electric company of Chicago, have just closed a contract with Menken & Co., dry goods dealers at Memphis, Tenn., for a 45 arc light plant complete, 18 incandescent lights and a 60 horse power engine.

The Electrical Supply Co., of Chicago, have located their selling agent, C. H. Cone, at 125 West Sixth street, room 18, Kansas City, Mo., where a complete line of samples will be carried. Mr. Cone is widely known throughout the west and southwest and therefore needs no commendation to the trade of those sections. On the other hand his company has shown wisdom in stationing him at so important a distributing point as Kansas City.

The Chicago Arc Light & Power Co. has placed an order for 15,000 feet of okonite wire to connect their switch board with the mains.

James W. Johnson, E. M. Hawley, and E. C. Loveland are the incorporators of the Northwestern Electric Accumulator company at Chicago. The capital stock is $65,000.

Forée Bain has removed from 95 and 97 Indiana street, to 76 Market street, Chicago.

The Tucker Electrical Manufacturing company have yielded the agency of the Mather Electric company for the states of Ohio and Missouri, retaining the states of New York, New Jersey and Pennsylvania. J. H. Reid, of the Chicago office of the Mather Electric company, will hereafter have charge of the Ohio and Missouri business.

Electrical Patents.

Issued Nov. 29, 1887.

373,859. Regulators for Electric Generators. Robert P. Sellon and William M. Mordey, Victoria Works, Belvedere Road, County of Surrey, England.

373,883. Application of Accumulators to Electric Lighting. Thomas P. Conant, Brooklyn, N. Y.

The invention consists in a series of accumulator cells connected in pairs and a switch for connecting each pair in multiple arc or in series as desired.

373,910. Telephone Call-Box. Charles E. Scribner, Chicago, Ill.

The switch lever is reciprocated to change the circuit, or the telephone is taken down and hung up. At each movement of the switch lever the teeth or rack of the lever engage with the driving gear of the generator.

The invention consists in the reciprocating switch for operating the generator as the telephone is hung up or taken down.

373,915. Induction-Telegraph System. Granville T. Woods, Cincinnati, Ohio.

373,925. Telegraph Pole Protector. Herschel P. Copeland, East Orange, N. J.

Designed to prevent linemen from disfiguring the poles with their climbers.

373,934. Electric-Arc Lamp. Charles A. Holmans, Winchester, Mass.

373,948. Winding Armatures of Dynamo Electric Machines. Charles E. Scribner, Chicago, Ill.

378,967. Telegraphy. Patrick B Delany, New York, N. Y.

An ordinary Morse key is used to transmit dots and dashes over circuits of high capacity by causing to be thrown upon the line impulses of electricity of alternating polarity and uniform duration.

373,968. Telegraphy. Patrick B. Delany, New York, N. Y.

373,971. Commutator Connection for Dynamo Electric Machines. James W. Easton, New York, N. Y.

The invention is stated in the sixth claim as follows: "The combination with the armature bobbins of an electric machine and the commutator as collector plates, of a fusible compressible connection between the same substantially as described."

373,975. Electrical Horometer. Ben M. Hammond, San Antonio, Texas.

374,013. Electrical Indicator for Weighing Scales. James E. Tarbox, Lynn. Mass.

374,017. Automatic Circuit Opener. Jacob P. Tirrell, Somerville, Mass.

374,028. Electric Door Opener. Albert C. Woehrle, New York, N. Y.

374,036. Circuit Closer. Charles B. Bosworth, Everett, Mass.

374,038. Telegraph Instrument. Charles G. Burke, Richmond Hill, N. Y.

This instrument is designed for receiving messages sent over lines having a high electro-static capacity like ocean cables. A coil or solenoid included in the main circuit is placed in an intense magnetic field consisting of two opposite magnetic poles derived from one or more electro-magnets.

374,072. Electric Temperature-Regulator. Warren S. Johnson, Milwaukee, Wis.

The invention claimed relates to a novel form of electro pneumatic valve and thermostat and to a special device for operating the registers. There are thirteen claims, the sixth being as follows: "(6) In a temperature regulator, the combination of a fan register, adapted to be operated by fluid pressure, with a locking device for holding the fans of said register in the position to which they have been adjusted"

374,088. Electric Organ Action. Hilborne S. Roosevelt, New York, N. Y.

374,103. Manufacture of Telegraph and other Poles or Posts David Wilson, County of Essex, England.

374,129. Arc Light. Clarence B. Noble, Cleveland, O.

The double carbon arc lamp described is of the Brush type, A solenoid having two windings, one of fine wire included in a shunt around the arc, and the other, a coarse winding, operates to shift the arc. When the carbons of the first set are nearly consumed current is shunted through the fine winding until the core of the solenoid is lifted. The core of the solanoid being thus lifted opens one pair of contacts and bridges over another pair of contacts so as to cause the main current to pass through the coarse winding, the circuit being at the same time shifted to the second set of carbons. A cut-out shunt and the lamp when the resistance of the second arc is abnormally increased.

The claims, three in number, are limited to the special devices shown.

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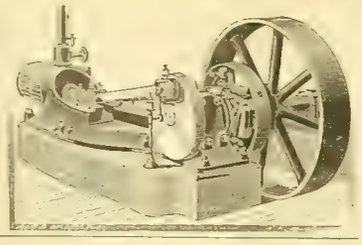

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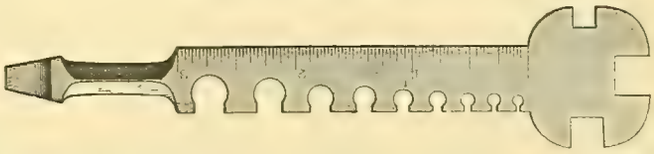

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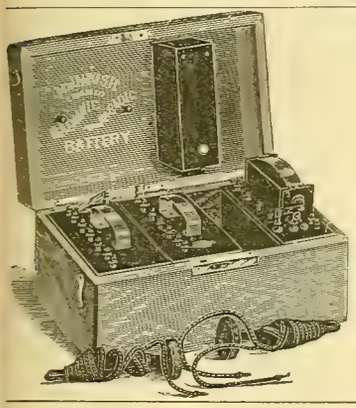

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MILLIAMPERE METER, MEDICAL DYNAMO, ELECTRIC BATH APPARATUS,
and EVERY VARIETY OF ELECTRICAL INSTRUMENT employed in treating disease.

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EXPERIMENTAL ELECTRICAL APPARATUS MADE TO ORDER.

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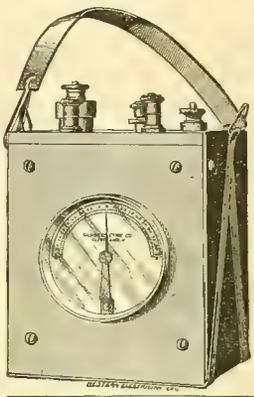

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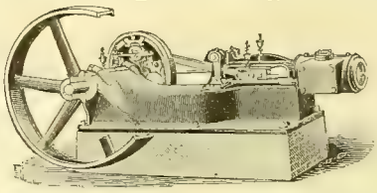

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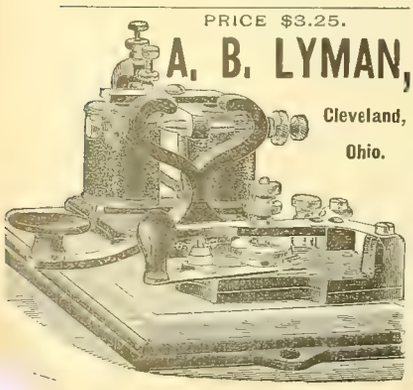

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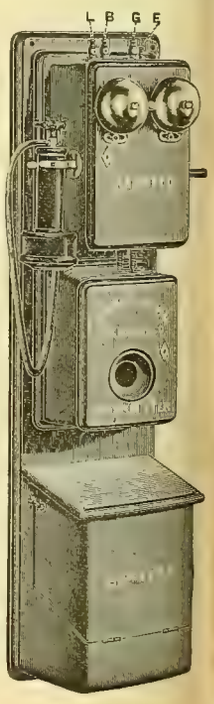

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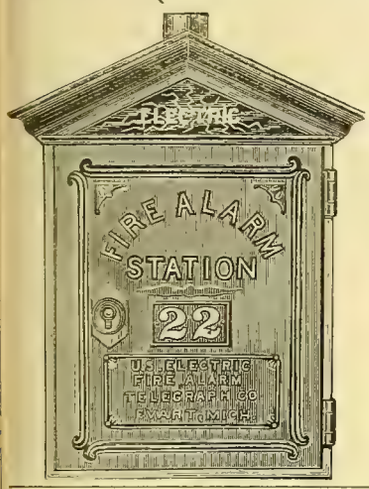

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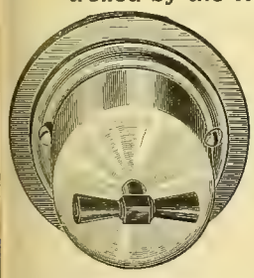

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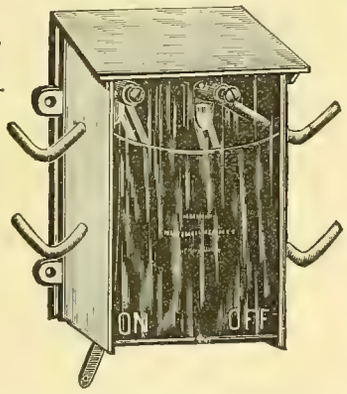

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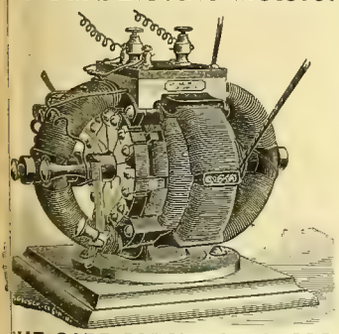

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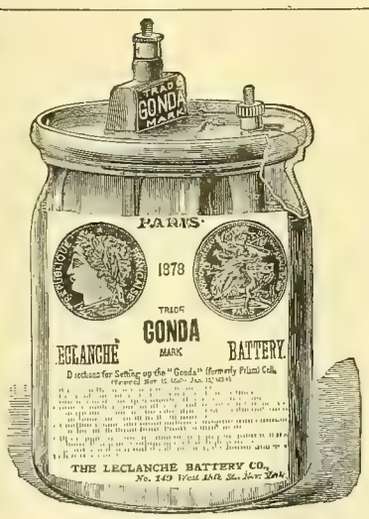

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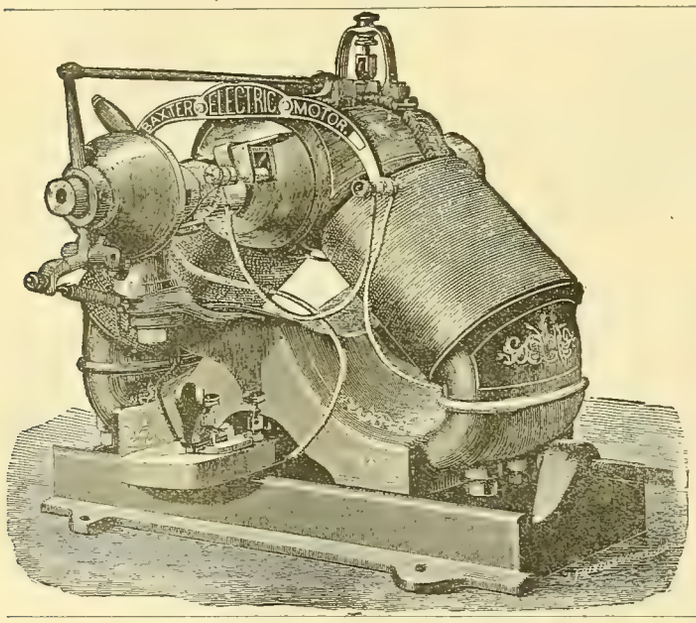

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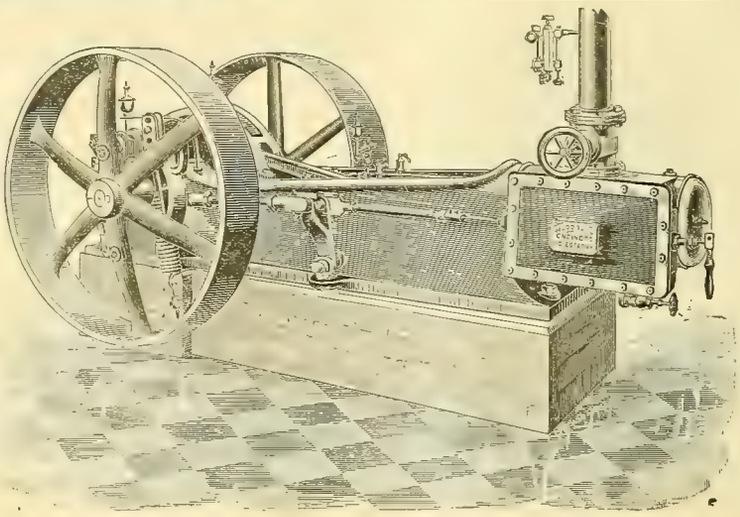

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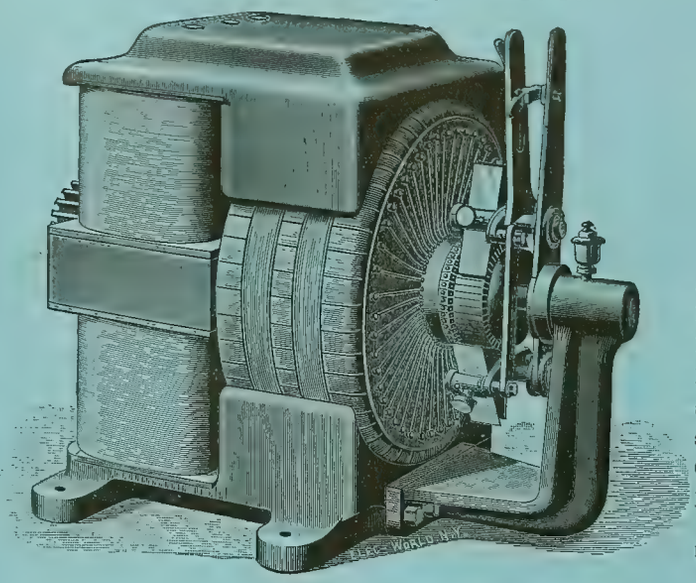

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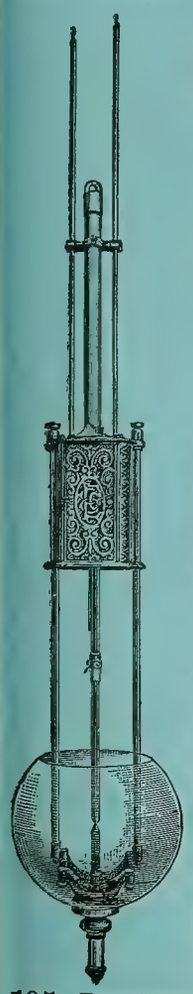

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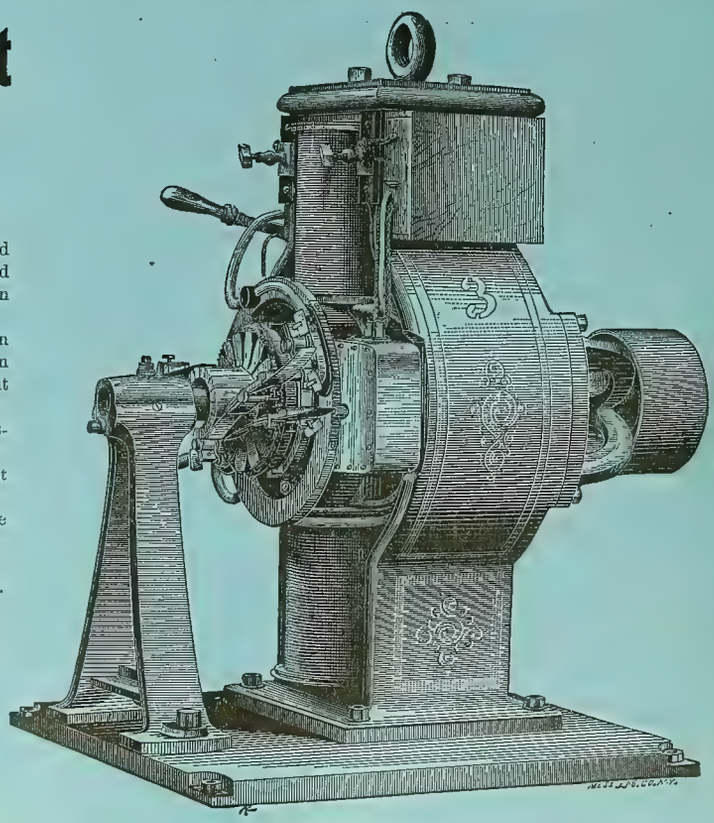

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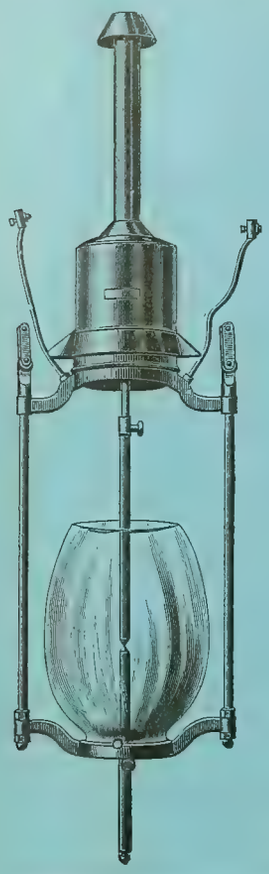

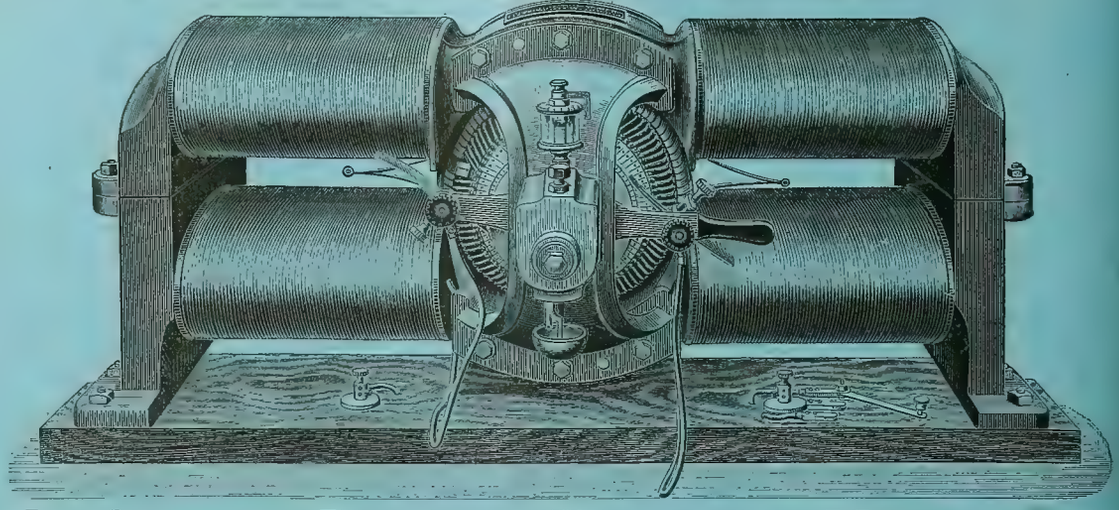

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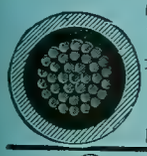

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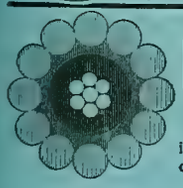

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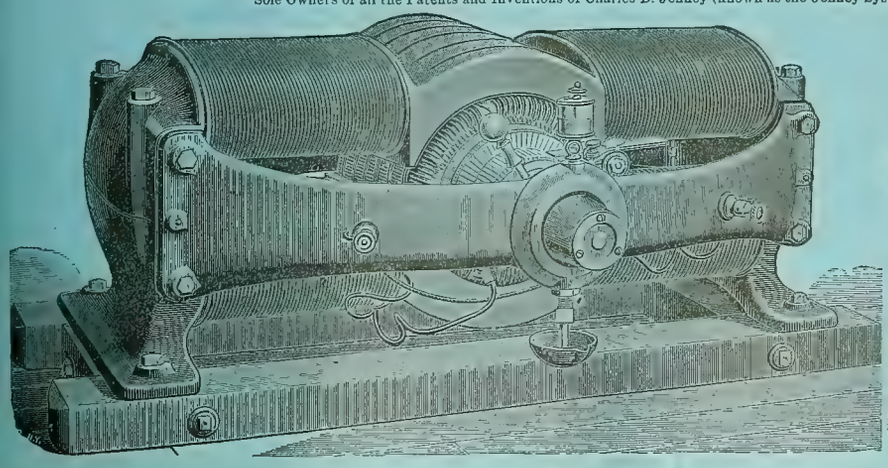
JENNEY ELECTRIC COMPANY.

OF INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

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The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

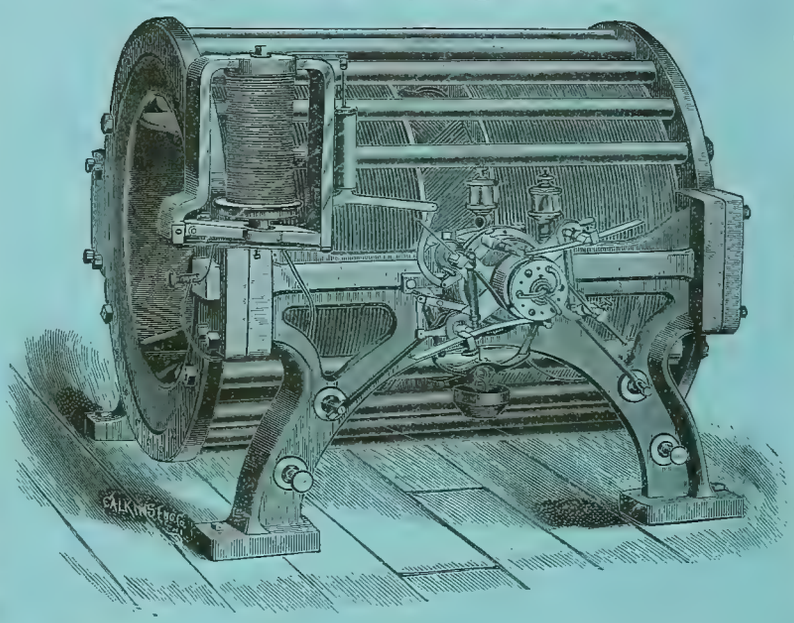
OF

Electric Arc-Lighting

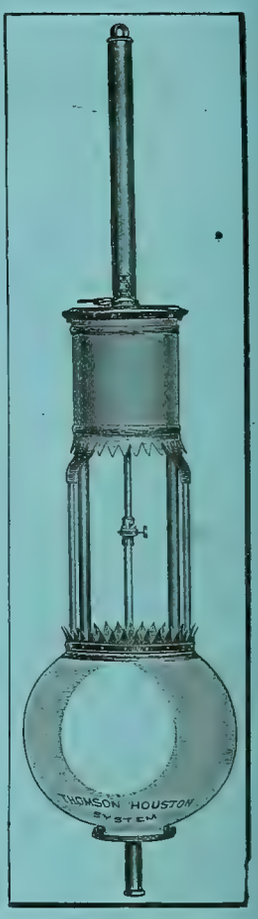
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

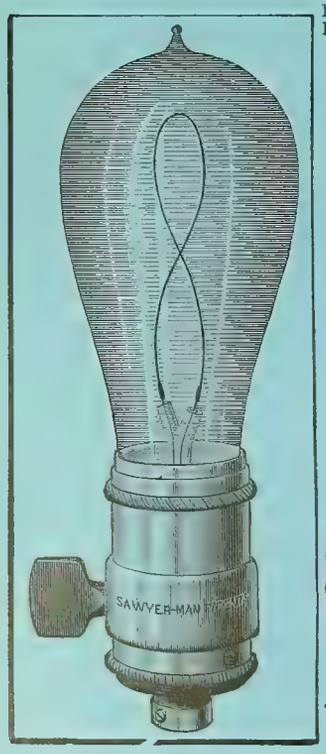


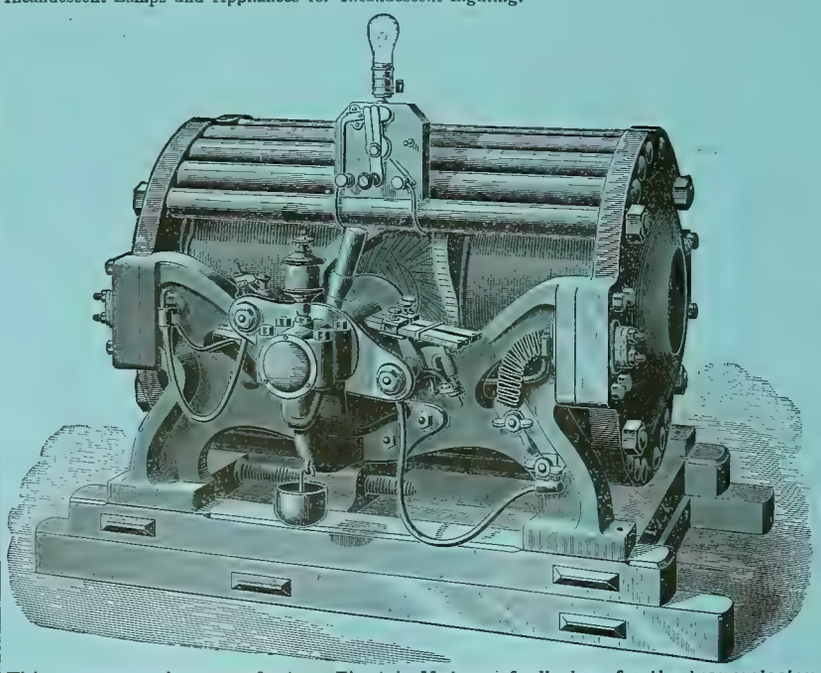
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT **LONG DISTANCE INCANDESCENT LIGHTING.**

These dynamos are automatic in their regulation and will maintain a uniform ight, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

EDISON'S NEW LAMP

IN

People's Theatre, Minneapolis.

12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

MINNEAPOLIS, NOV. 17, 1887.

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GENTLEMEN:

The Electric Light put in my Theatre by your company is far beyond my expectations. Its system of lighting is perfect and is all that your representative claims for it.

Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,

LAMBERT HAYS,
Proprietor People's Theatre.

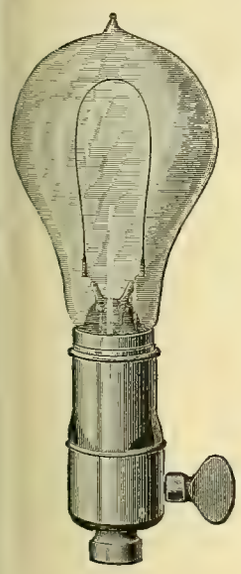
Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO., 185 DEARBORN ST., CHICAGO.

The United States Electric Lighting Co.

MANUFACTURE LATEST IMPROVED

Incandescent Lighting Systems

FOR ISOLATED AND STATION LIGHTING PURPOSES



SUPERIOR TO ANY OTHER SYSTEM BECAUSE OF

More Light for a given amount of Power. Greater durability of Incandescent Lamps.
Better Mechanical Design and Workmanship. Absence of discoloration of Incandescent Lamp Globes.
The only Automatic Regulation in Dynamos. Completeness of details.
Precision and Reliability of Measuring Instruments;

AND BECAUSE OF

The only reliable system of comparatively low tension long distance incandescent lighting, using conductors of low cost. Mains costing approximately **$2.80 per lamp for a mile,** losing only five per cent. of current from dynamo to lamps;

AND ALSO BECAUSE OF

Incomparably the best **Alternating Current** or Secondary Generator System (high tension) extant, same covered by *fundamental patents*, and which are not used for advertising purposes, but for the protection of the users of our apparatus. In the use of this system, conductors (mains) at three per cent. loss cost approximately **70 CENTS PER LAMP FOR A MILE.**

BEWARE OF PARTIES POSING BEFORE THE PUBLIC WITH SO-CALLED ALTERNATING SYSTEMS

claiming rights under Gaulard & Gibbs' patent, No. 351,589, which has been found to be impractical and has been abandoned, and who are now infringing patents owned by the United States Electric Lighting Company, substituting same for their uncommercial and discarded system.

C. C. WARREN, WESTERN MANAGER,
216 La Salle Street, Chicago.

General Offices, Equitable Building, 120 Broadway, New York.

THE NATIONAL CARBON CO.

CLEVELAND, O.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

American Electrical Works,

PROVIDENCE, R. I.,

EXCLUSIVE MANUFACTURERS OF THE

FARADAY CABLE

—FOR—

Telegraph, Telephone and Electric Light.

Highest Insulation and Lowest Inductive Capacity of any Cable in the Market.

New York Office, 18 Cortlandt Street.

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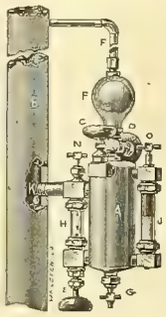

The Detroit Sight Feed Lubricators

Are pronounced the best by more than 20,000 users. They are especially adapted to

HIGH SPEED ENGINES FOR ELECTRIC LIGHTING

Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

Liberal discount to the trade. Send for Circular and Price List.

DETROIT LUBRICATOR CO.

Office, 11 Rowland Street, - DETROIT, MICH.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS OF

Steam and Hydraulic Machinery.

Complete Steam Plants for Electric Light and Power.

Western Agents for Armington & Sims' Engines, Steel Tubular Boilers, Jarvis' Patent Furnace, National Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Jenkins' Bros. Valves, Etc. Also, Brick and Pipe Work, and Belting.

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MANUFACTURERS OF

Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

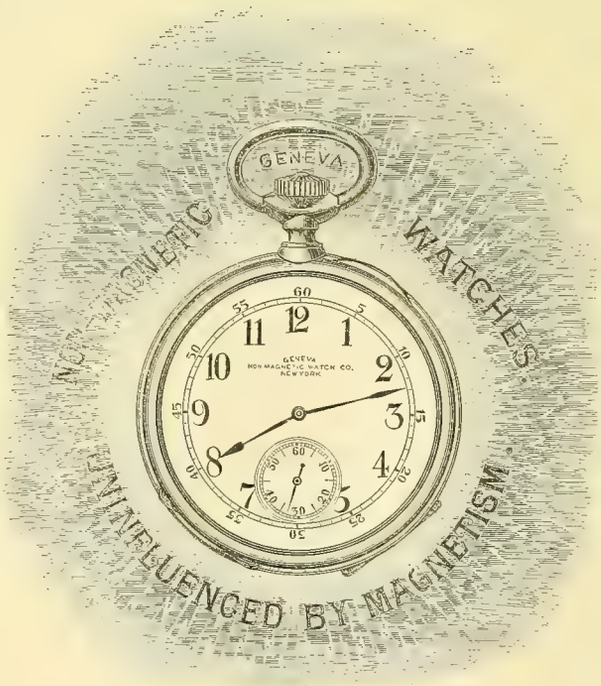
Western Agency, 185 & 187 Dearborn St., Chicago.

Geneva Non-Magnetic Watch Co.

(LIMITED.)

Containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring, which are absolutely exempt from magnetism and will not rust or corrode.

Ask your Jeweler for them.



Every watch is a fine timekeeper and accurately adjusted to temperature. As these non-magnetic qualities are in the works, they require no shield or other protection.

Send for Catalogue.

177 & 179 Broadway, New York.

EDISON'S OPINION.

Geneva Non-Magnetic Watch Company:

Gentlemen:—During the past six months I have submitted the watches containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring to test in different fields of magnetism. I find them exempt from magnetic influence, however strong, and practically no retardation of the balance, nor change in rate occurs, even when in actual contact with Dynamos or powerful Electro-Magnets.

I have been carrying one of your watches, and going around Dynamos and other Electrical Appliances, where I have never been able to carry a watch without ruining it, and it has proved an excellent time-keeper. I consider Paillard's Balance a most wonderful and valuable invention, not only for workers around Dynamos, but wherever accuracy of time is required.

Very truly,

Orange, N. J., Dec. 7th, 1887. *T. A. EDISON.*

STANDARD ELECTRICAL WORKS,

MANUFACTURERS OF

HOTEL AND HOUSE ANNUNCIATORS **Telegraph and Telephone Apparatus,** BURGLAR ALARMS.

SOLE MANUFACTURERS OF THE

HESS SYSTEM OF GUEST CALL, FIRE ALARM AND ANNUNCIATOR COMBINED.

CALL BELLS, "POST'S" MAGNETO BELLS, PINS AND BRACKETS, BATTERIES, ETC. ETC.

In Stock: Full Line of Iron, Steel and Hard-Drawn Copper Wire, Delivered at Lowest Prices.

ESTIMATES FURNISHED. SEND FOR CATALOGUES AND PRICES. **CINCINNATI, OHIO, U. S. A.**

THE IMPROVED "LAW PRISM" BATTERY

SIZE OVER ALL, 4¼ x 4¼ x 7½.

THE NEATEST OF ALL BATTERIES. THE BEST AND CHEAPEST.

With the exception of glass broken by carelessness, and the zinc and sal-ammoniac consumed in the production of current, **all parts of this Battery are Guaranteed** to be **Everlasting.** Perfectly **uniform** and **reliable** in action, of **faultless construction** and **beautiful appearance.**

PERPETUAL NEGATIVE ELEMENTS!!!

These consisting of specially prepared prisms of Carbon are fine depolarizers, performing this function indefinitely, **do not require renewal,** as is the case where chemical depolarizers are employed, thus a **great economy** is effected. These cells are so constructed as to prevent evaporation of the solution, and crawling out of the salts. Thousands of these cells now employed for **Telephone Transmitters, Gas Lighting, Annunciators, Burglar Alarms** and other **Automatic Devices** are giving **Perfect Satisfaction.**

The many Physicians now using the "**Improved Law**" as an office battery, are unanimous in their expressions as to its perfection and adaptability for electrolysis and general galvanization, requiring no renewal nor attention in from two to five years, the latter depending only on the amount of use.

Note:—This battery is not suitable for Galvano Cautery nor Incandescent Light purposes.

LAW TELEPHONE CO., Sole Manufacturers, 112 LIBERTY ST., NEW YORK.

PAYNE AUTOMATIC ENGINE.

B. W. PAYNE & SONS, MANUFACTURERS, ELMIRA, NEW YORK.

BUILDERS OF

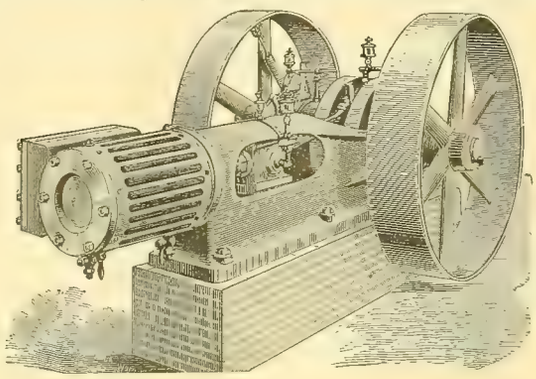
Single Valve and Corliss Valve

ENGINES.

SELF CONTAINED AND SINGLE CRANK

ENGINES

Specially Adapted for Electric Lighting.



WESTERN DEPARTMENT:

No. 10 S. Canal St.

CHICAGO.

H. S. WALKER, MANAGER.

TELEPHONE 4024.

We have a considerable quantity of **KERITE WIRE** size No. 13 B. & S. Gauge, 6-32″ insulation, which has been in use, but is practically as good as new.

We will send a sample of this wire and quote a very low price to any one who inquires.

WESTERN ELECTRIC COMPANY

CHICAGO—NEW YORK—ANTWERP—LONDON.

THE EDDY ELECTRIC MANUFACTURING CO.

MANUFACTURERS OF **Automatic Electric Motors** (MATHER PATENTS.)

In all sizes from ½ H. P. upwards. The efficiency of these Motors is over 92 per cent. They require no rheostat, are perfect in regulation, simple in construction, and thoroughly and substantially built. Also manufacturers of

THE MATHER DYNAMO ELECTRIC MACHINE,

FOR ELECTRO-PLATING, ELECTROTYPING, COPPER REFINING, ETC.

These Machines cannot reverse, use no water, do not spark, and are noiseless. Satisfaction Guaranteed.

THE EDDY ELECTRIC MANUFACTURING CO., HARTFORD, CONN.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, DECEMBER 17, 1887. No. 25

New Ampere and Voltmeter.

A new ampere and voltmeter designed by F. Uppenborn is shown herewith. In the illustration, *a a* represents a solenoid whose inside is partly covered with a soft iron shell *b*. A concentric cylindrical body is movable around the axis *d*. One part of the surface of this cylinder is covered with a soft iron shell *c*. Hand *h* is fastened to the movable cylinder; *S* is the scale.

When the current passes through the solenoid *a*, the iron plates *b* and *c* are magnetized and the like poles repel each other. In order to have the cylinder turn only one way the iron plate *c* projects a little over *b* on one side.

Instead of using the repelling forces the instrument could be so changed as to use the attraction of the fixed and movable iron plates.

All measuring instruments in which the magnetization of soft iron is used will, however, not show the same deflection for the same value—amperes or volts. This is due to the residual magnetism. The angles of deflection in the Uppenborn meters will of course not be in proportion to the current strength or to the e. m. f. The degrees on the scale near zero will be small and gradually become wider towards the other end of the scale.

Noteworthy Changes.

Changes of more than ordinary interest to the electrical fraternity of Chicago and vicinity are promised for the first of the new year.

C. N. Fay, second vice-president and general manager of the Chicago Telephone company and president of the Chicago Arc Light & Power company, has resigned both offices to accept the presidency of the Gas trust of Chicago. The high honors that Mr. Fay has already borne evince the appreciation in which his abilities are held. No definite announcement can be made as to who will be chosen to fill his place in the telephone company, but rumor has it that his successor will be George L. Phillips of the Central Union Telephone company.

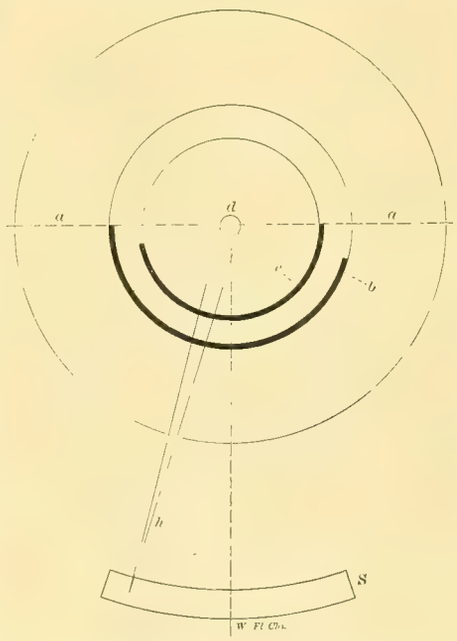
B. E. Sunny, at present the superintendent of the Chicago Telephone company, is to receive congratulations upon his elevation to the presidency of the Chicago Arc Light & Power company. Mr. Sunny, although comparatively a young man, is eminently well fitted by education and business experience for the new office which he has been selected to fill, and it is believed that he will perform the duties of the office with an ability equal to that which has characterized his administration of the office he now resigns.

Undoubtedly both Mr. Fay and Mr. Sunny will feel some regret at leaving the Chicago Telephone company. Both became connected with it about the same time, in 1879. That year there were 400 subscribers to the exchange. Tuesday of this week—and it is well to be definite as to date, inasmuch as the Chicago Telephone company is a vigorous, growing institution, and statistics for one day will hardly hold good for that day week—the Chicago Telephone company had 4,750 city subscribers, 800 country subscribers, 500 private lines, controlled a burglar alarm service, a watch service, an American district messenger service and a toll service. With the growth of the ramified business of the Chicago Telephone company Mr. Fay and Mr. Sunny have been prominently identified, and the instrumentality of both has left its imprint. But both gentlemen are called to positions of increased responsibility and honor and will unquestionably secure a similar appreciation in their new spheres to that accorded them in those they are about to leave.

The Desmazures Secondary Battery.

This battery recently attracted some attention among electricians by its performance at Havre, where one weighing 4,400 pounds propelled a launch weighing 11,000 pounds for five hours at the rate of 6.5 knots per hour. The brief note that was made of the battery in these columns is supplemented by the following by M. E. Reynier in *Moniteur Industriel:*

The negative plates of this cell are made of tinned iron; the positives are plates of porous copper, obtained by compressing the pulverized metal under 600 to 1,200 atmospheres. The liquid is a solution of zinc in sodic hydrate, or a solution of potassic hydrate added to chlorate (*sic*) of sodium. The cell is made of tinned iron; it is entirely closed in, and is connected with the negative plates.



During the process of charge metallic zinc is deposited, and is taken up in solution during discharge. The oxides of copper are not completely insoluble in the caustic alkalies. In order to avoid the solution of the oxides in the electrolyte, and their reduction upon the zinc, the positive plates are enclosed in bags of parchment-paper supported by vertical rods of glass, which also serve to insulate the plates. The following figures relate to a cell of type number 4:

Number of positives plates	5
" negative "	6
Total weight of plates	13.2 lb.
Total weight of cell	44 lbs.
E. m. f. on open circuit	1 volt.
External e. m. f.	.85 "
Charging current	18 amperes.
Maximum discharge current	36 "
Capacity	372 ampere hours.
Work done in discharge	.42 horse power hour.
Weight of plates per horse power hour	66.5 lb.
Total weight horse power	99.5 "
Weight of plates for horse power (output)	323 5 "
Total weight for h. p. (output)	1078.0 "

But the battery employed in the Havre experiments seems to have shown better results than these as regards weight. The battery of 132 cells weighed 4,400 lbs. It gave during five hours a current of 87 to 89 amperes under a potential of 100 to 104 volts. We thus get: Total weight per horse power hour 72.6 lb. Total weight for one horse power (output) 365.5 lb. A considerable reduction of weight has thus been effected, but on the other hand the available e. m. f. has fallen to .78 volt per cell.

But the weight of 365.5 lb. per horse power is not remarkable; it had already been obtained—upon the same boat—by Reynier accumulators with corrugated plates, in November last year. But for ratio of work—horse power hours to weight, the Desmazures cell is superior to any Planté cell as yet in the field. It is also claimed that the cell has a very high coefficient of restitution. *A priori* it may be admitted that this will be the case as regards the ampere hours, because the electrolysis of alkaline zincates is not accompanied by the evolution of gas, and yields deposit of zinc of very regular and very adherent character.

But, on the other hand, we have to remember the loss of e. m. f. In my own experiments I have found that while it takes an e. m. f. of at least 1.2 volt per cell to charge this type, we do not get more than about .65 volts in the discharge.

The duration of the negative plates will no doubt be very great in this cell, as in all others. As to the positives I am not so sure. The flakes of greenish blue are not reassuring; the parchment paper will certainly be attacked by the caustic alkalies. The inventor should amend this detail.

Should the relative lightness of the caustic alkali cell induce us to abandon the Planté type? What is the probable future of the two systems?

While waiting for an answer from practice we may interrogate theory, and we shall learn that in principle the Planté type is preferable to the other, even in point of view of lightness. Let us compare the weights required in the two systems for the same output, for example 3,600 kilogrammetres.

PLANTÉ TYPE.

Available Difference of Potential 1.8 Volt.

	Grammes
Lead	42.21
Oxygen	3.26
Sulphuric acid	20.00
Water	40
	105.47

CAUSTIC ALKALI TYPE.

Available Fall of Potential .8 Volt.

	Grammes.
Zinc	15.1
Cuprous oxide	18.3
Potassic hydrate	25.7
Water	77.1
	136.2

Theoretically, therefore, the Planté cell is lighter by 23 per cent.

The actual lightness of the Desmazures cell is due to a better utilization of the essential elements. The excessive weight of the lead elements is above all due to the mass of inert metal which acts merely as a conducting support for the active material. If this dead weight could be suppressed or diminished it would make a surprising difference I have myself obtained remarkable results in this direction, but to avoid introducing the personal element let me be con-

tent to refer to the plates of Mr. FitzGerald which are exclusively composed of lead peroxide, with a thin conducting plate of platinum. These cells are said to answer very well, and they give a horse power hour with a weight of less than 73 lbs.

It seems, then, not difficult to realize in practice the theoretical superiority of the Planté cell in the matter of weight. We ought also not to lose sight of the fact that the lead cells occupy much less space than the other type. This is frequently an important point.

In the matter of first cost it is necessary to remark that copper and potassic hydrate are more expensive than lead and sulphuric acid. In fact, in combining the figures for theoretical weight and cost of material for the same output, we find that the first cost would be about four times as great for the alkali as for the acid cell.

Phenomena of Retardation in the Induction Coil.[1]

BY WM. STANLEY, JR.

This paper will attempt to emphasize the time relations of the alternating e. m. f.'s. and currents in the induction coil. Any description of the phenomena of retardation accompanying the inductive effects of currents would necessarily be incomplete and unintelligible without a clear conception of the fundamental principles of the induction coil. This must be my excuse for briefly recalling to you the rudiments of the induction system.

An alternating e. m. f. differs from a direct e. m. f. in two important points: It varies continuously, and its direction or polar tendencies alternate.

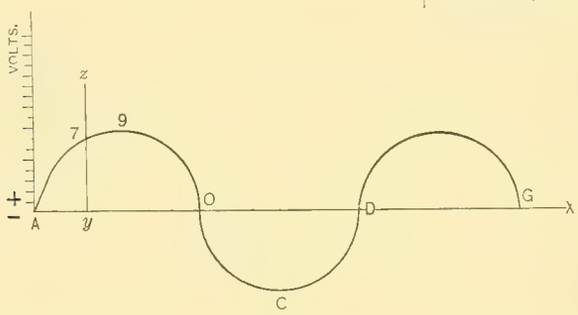


Fig.1.

Fig.2.

To illustrate graphically the various values of an alternating e. m. f. and the attending phenomena, it is usual to plot a series of curves above and below a straight line. This line, when divided in equal divisions, may be taken to represent successive periods of time, Fig. 1. Starting at the point *A*, the e. m. f. is seen to rise rapidly above the line *A X* in a gentle curve —the particular curvature of which depends on the construction of the generator—until at 9 it reaches its highest point; thence it flows downward in a similar but reverse curve, until it again reaches the line *A X*, and, continuing downward, finally attains a sub-maximum at *C*. From this point it rises again, crossing the line *A X* once more at *D*, whence a repetition of the former curves occur.

The e. m. f. of the alternating current at any particular time can be determined by the distance of the curved line above or below *A X* at that time. For instance, suppose we wish to determine the e. m. f. at any time, *y*. Through *y* draw *y z* perpendicular to *A X*, cutting *A* 9 at *F*. Then 7 *y* represents the e. m. f. applied to the circuit at the time *y*.

From an examination of the curve it will be seen that at stated intervals of time *A O D G* there is no e. m. f. applied to the circuit; and, if the curves above the line *A X* represents e.m.f.'s applied in one direction, those below the line *A X* represent e. m. f.'s in the opposite direction. Hence adjacent e. m. f.'s alternate in direction, and hence the term alterating currents.

There is a general misunderstanding to the effect that the alternate current dynamo is less economical than is the direct current generator. This is not so; there is a little difference, it is true, but the difference is, I believe, in favor of the alternate current machine. Let us take a dynamo field for example, that of a simple direct current type of dynamo, and separately excite it with a constant current; let us now wind two armatures of identical dimensions, one for direct and one for alternate currents and arrange to run them at the same speed; and let the windings of the two armatures be identical in size and number of turns of wire. Now the e. m. f. produced in these two armatures will be found to be, for the direct current armature:

E. m. f.	X volts.
Resistance of the armature	R ohms
Amperes per section of winding	A amperes

And because the armatures are identical we have for the alternate current dynamo:

E. m. f.	$2X$ volt.
Resistance of the armature	$4R$ ohms.
Amperes per section of conductor	$\frac{1}{2}A$ amperes

Thus the direct current dynamo will generate $A X$ watts, and the alternate currant dynamo $2X \times \frac{A}{2}$, or $A X$ watts, also. Hence the capacities of the armatures are equal.

The loss of energy in the armatures will be, for the direct current dynamo, $A^2 R$ watts. For the alternate current dynamo $\left(\frac{A}{2}\right)^2 \times 4 R$, equals $\frac{4 A^2 R}{4}$, or A^2 R watts. From this we learn that the losses in the armatures are equal. It is stated, however that, owing to self-induction, Foucault currents, or something else, these figures do not represent the actual waste of energy. The waste of energy by self-induction in the direct current dynamo occurs when a brush on the commutator touches two adjacent strips at the same time, as in Fig. 2. The arrows indicate the direction of the induced currents, and show that at that time all the e. m. f. of the short circuited coil is wasting current on a short circuit through the brush. What now is the loss in the alternate current dynamo through self-induction?

In the direct current dynamo the current flowing through the armature coils magnetizes the armature with a polar line at an angle to the polar line of the field. These armature poles maintain a constant position relative to a fixed point, and are of a constant value. In the alternate current dynamo, the current in the armature rises above and falls below a zero value periodically; hence the iron in the armature has periodic polar tendencies at an angle to the polar line of the field.

I shall endeavor to show that instead of wasting energy by periodically polarizing the armature, the e. m. f. devoted to this purpose is at first temporarily stored and subsequently returned. As is well known, a certain period of time is required to establish a given magnetic charge in iron, which time is directly proportional to the degree of magnetization to be attained. If, therefore, we plot a curve, the abscissæ representing time and the ordinates the degree of magnetization, and if we apply this curve to the curve of e. m. f. producing it, we have two similar curves separated from one another by a given period of time, as shown in Fig. 3, where 1, 2, 3, 4, 5 represents a curve of e. m. f., and 6, 7, 8, 9, 10 the corresponding curve of magnetization.

When the coil on the alternate current armature leaves a pole of the field—during rotation—the lines of force threading it rapidly diminish, and by induction generate an e. m. f. in the coil. The rise of e. m. f. and consequent flow of current in the coil is attended by a magnetic polar effect in the iron core, which not only increases while the e. m. f. is rising from 1 to 2, but continues to increase, attaining its maximum value when the e. m. f. has fallen to *K*. Up to this time, namely, the time when the magnetic charge is maximum, energy has been expended upon the iron core; but notice, that at this time the charge on the iron core is superior to the charge producible by the e. m. f. at that instant; consequently, the charged core does positive work upon the e. m. f., if I may use the expression, and in doing this decreases its own value.

This auxiliary e. m. f. developed by the magnetized core upon the armature conductor assists the e. m. f. proper; that is, the e. m. f. developed by the field magnets. Thus the energy devoted to magnetizing the armature, during the rise of

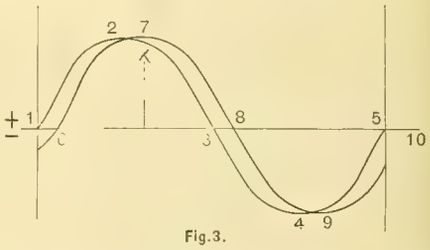


Fig.3.

wave of e. m. f., is returned as e. m. f. during the fall of potential. We may assume that the wave is shifted along or retarded. Fig. 3 illustrates this retardation. 1, 2, 3, 4, 5 is the curve representing the position of a wave of e. m. f., without taking into consideration the effect of the iron core, while 6, 7, 8, 9, 10 is the curve wave of e. m. f. which has been retarded by reason of the magnetic charge on the iron from the theoretical position, 1, 2, 3, 4, 5.

The curve of e. m. f. of a coreless armature is quite different; here, as before, the theoretical curve is *A B C D E* Fig. 4. Let us see what the effect of self-induction is in this case.

We know that self-induction is proportional, among other things, to the current flowing at a given time. Now, at the time *A* no current flows; hence, there is not self-induction. But as the e. m. f. rises, and current is driven through the coil, the self-induction or counter e. m. f. prevents the e. m. f. from attaining its theoretical value. It does not delay the e. m. f. from its theoretical time position, as is the case with an iron core, but prevents the e. m. f. from attaining its theoretical maximum value at any time. The real curve of e. m. f. in this case would be *A G C H E* Fig. 4. This curve shows that there is no waste of energy due to counter e. m. f. but that the armature output is reduced by self-induction. An iron core, therefore, causes the counter e. m. f. to oppose the e. m. f. proper only during one-half a period, and allows it also to assist the e. m. f. proper during the other half period in the phase.

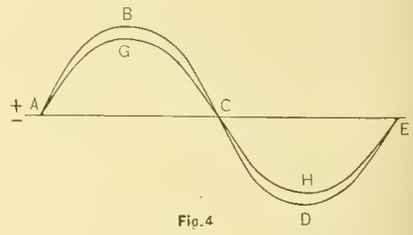


Fig.4

It is evident that the time of retardation, viz, the distance between 1, 2, 3, 4, 5 and 6, 7, 8, 9, 10, Fig. 3, depends on the quantity of current flowing through the armature coils, as well as on the core. I have described this point at length, as there is a general, although false, impression that the iron core of an alternating armature necessarily wastes energy.

We may roughly compare the theoretical efficiencies of the direct and alternating dynamos, as follows: The output is equal; the waste of energy in armatures due to $C^2 R$ is equal. The waste due to self-induction is greater for direct than alternating dynamos, with properly constructed iron cores.

Faraday's law of induction may be stated as follows: The variation of the magnetic field surrounding a conductor induces an e. m. f. in that conductor. A variable field is produced by a var-

1 Read before the American Institute of Electrical Engineers, New York, Dec. 6, 1887.

iable current, and hence, a conductor carrying an alternating current will induce an e. m. f. in another conductor residing in the same field.

Let us note the values of the e. m. f.'s in the inducing or primary, and induced or secondary circuits, at the same time, and first when no current is flowing. The curve, *A B C D E* Fig. 5, represents, as before, the alternating applied e. m. f. Now the induced e. m. f. will be a maximum at the time when the inductive effect of the primary current is a maximum, and the inductive effect of the primary will be greatest when its e. m. f. is changing most rapidly. Evidently this will occur near the zero line *A X*;

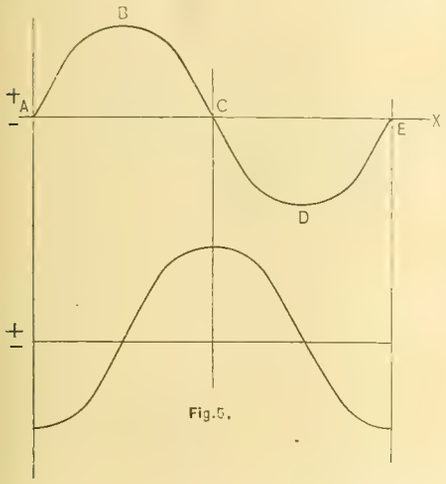


Fig.5.

for the e. m. f. will vary most when passing from a finite value to zero, or from zero to any finite value. Hence the inductive effect of the primary and the e. m. f. developed on the secondary circuit will be a maximum when the primary e.m. f. is least.

Fig. 5 represents the time relation of the primary and secondary e. m. f.'s when no current is passing. The position of the maximum e. m. f. of the secondary is, as you see, one-fourth of a complete period behind that of the primary. Now a moment's consideration will show that the secondary circuit is simply the receptacle of an e. m. f., and, when no current is flowing in it, plays no part in the inductive phenomena.

The primary circuit evidently will induce in itself an e. m. f. in the same manner that it impresses the e. m. f. on the secondary circuit. Hence, in any circuit to which is applied an alternating e. m. f., we have two phases of e. m. f.; the one, the applied; the other, the self imposed; the points of equal value in each being distant from each other one-fourth of a complete period. When practically no current is flowing, this self-impressed e. m. f. is called "self induction," or counter e. m. f. When two or more coils are wound together so

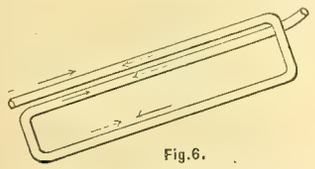


Fig.6.

as to act collectively, the effect of the one upon the other is termed "mutual" induction. We now see why, when an alternating e. m. f., of, say, 1,000 volts, is suddenly applied to a coil whose resistance is low, as, say, 1 ohm, the coil does not receive the quantity of current destined for it by Ohm's law. The kinetic e. m. f. is very small, because it is the difference between the applied and counter e. m. f.'s.

Fig. 6. shows a wire wound on itself or coiled. The full arrows indicate the direction of the applied e. m. f., the dotted arrows the counter e. m. f. In the two adjacent turns one impresses a counter e. m. f. on itself and also a counter e. m. f. on the other, and latter again impresses a counter potential on itself and on the first. Hence in two coils of wire we have four impressed counter e. m. f.'s. This is commonly stated as the self-induction, and is proportional to the square of the number of turns.

We will now consider the time position of the currents flowing through coils impelled by the e. m. f's of which we have spoken, and endeavor to apply the effects of the various positions they assume to a few of the phenomena noticed in working induction coils with different current strengths.

Evidently when little current is flowing over a conductor, the self-induction and retardation are small; hence the curve of the current nearly coincides with the curve of e. m. f. Fig. 7 illustrates the positions. Here the phase of the primary current nearly coincides with the phase of its e. m. f. The curve of the secondary e. m. f. is, however, just one-fourth of a period later than the primary current phase, while the curve of the secondary current is still further behind it; so that, while the primary current phase is a distance *X* behind the primary e. m. f. phase, the secondary current phase is 2*X* plus one-fourth of a period behind the primary e. m. f. phase. This delay reacts on the primary e. m. f. The lower curve in Fig. 7 is the curve of the counter e. m. f. developed by the secondary current upon the primary circuit. It will be noticed that it no longer exactly opposes the phase of the applied e. m. f., for the time line *A B*, passing through the maximum position of the primary e. m. f., cuts the counter e. m. f. curve at a point before its maximum value is attained.

Fig. 8 shows an extreme case. Here the curve of the primary current is one-eighth of a period behind its e. m. f. Consequently, the curve of secondary current is one-half a period behind the primary e. m. f., *i. e.* $\frac{1}{8} \times 2 + \frac{1}{4}$; and the curve of counter e. m. f. developed by the secondary current is three-fourths of a period behind the primary e. m. f.

We are now prepared to understand why the counter e. m. f. developed in the induction coil varies in its counter effect as current is abstracted from the coil. The reason is simply that its position of counter effect is dependent on the curve of its producing current, and as the current occupies a variable position relative to the applied e. m. f., the counter e. m. f. successively occupies positions of lesser counter effect until eventually it has no counter effect whatever.

These phenomena are taken advantage of in the operation of induction coils. If a constant e. m f. be applied to the primary circuit of a converter, successive increments of current will be allowed to occupy this primary circuit, as successive quantities of current are abstracted from the secondary circuit; because these currents push along out of the way the opposing counter e. m. f., and consequently the kinetic e. m. f. attains correspondingly greater values.

Thus far we have considered only two factors of self-induction and retardation, namely, the number of turns of the conductor, and the quantity of current flowing; but there is another factor, most important, and that is, the resistance of the magnetic circuit.

The magnetic resistance of iron is, as you know, similar to the resistance of any other conductor, in that it is directly proportional to the length and inversely proportional to the sectional area of the circuit. This, however, is only true for limited values. As the magnetic lines traverse a core they encounter a resistance proportional to their number at first; but if more lines be continuously added, a number is eventually reached which the iron utterly refuses to carry. This degree of magnetism is termed "saturation."

It can be shown that the position of the curve of counter e. m. f. is directly connected with the degree of saturation of the core, so that with a given coil the position of no counter effect of the counter e. m. f. coincides with saturation of the core. The magnetic resistance of the core of an induction coil determines, then, the limit of retardation or lag of the current phase. Hence, if we wish to construct a coil, in which the counter e. m. f. shall always be inversely proportional, and the kinetic applied e. m. f., always directly proportional to the current abstracted from it, we make the core of the coil with the lowest possible magnetic resistance. Such a coil, when supplied with a constant difference of potential, will furnish at its secondary terminals an approximately constant e. m. f. It is also evident that a coil having a limited section of core supplied with a constant current may deliver a constant e. m. f. on its secondary terminals, provided the field produced by the constant current is sufficient to saturate the core.

I noticed these phenomena several years ago when experimenting with a series system for lighting. O. B. Shallenberger has applied this saturation effect in a most striking manner. He connects a number of incandescent lamps, say four, in series, attaching their outer terminals to a source of constant alternating e. m. f. Around each lamp is shunted a self-induction coil, so proportioned that an e. m. f. of say 100 volts will saturate the core of the coil. If, now,

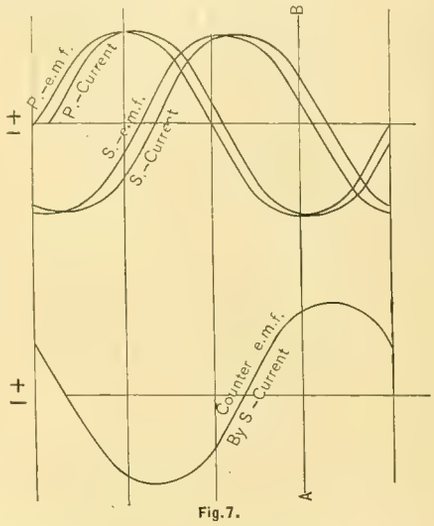


Fig.7.

a lamp be turned off, its current is diverted through the shunted coil, which offers a counter e. m. f. of 100 volts. We would naturally expect that the light in the remaining lamps would grow dim, but this is not the case. If we measure the difference of potential on the extreme terminals of the lamps, we find it to be 200 volts; on the three burning lamps it is 50 volts each, while on the shunted coil it is 100 volts; so that the sum of the potentials of the three lamps and the coil is 250 volts, while the applied e. m. f is but 200 volts.

I think the explanation is as follows: During the first part of the rise of the e. m. f. wave, the shunt coil practically offers an infinite counter e. m. f., in comparison with which the resistance of the lamp may be neglected; when, however,

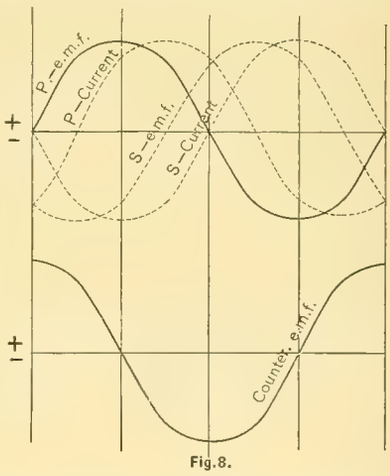


Fig.8.

the applied e. m. f. has attained a value of 100 volts, this counter e. m. f. is surmounted, because the core of the coil is saturated by the current flowing in the coil.

The lamps, therefore, receive the remaining 100 of the 200 volts applied, since the coil, being saturated, offers no additional counter effect. Now, after the wave of e. m. f. has declined to a value less than 100 volts, the stored magnetism in the core of the shunted coil begins to lose strength, and in so doing, develops an additional e. m. f., which, assisting the generator current, furnishes a current during the time the applied e. m. f. is of low, or zero, value, and by so doing keeps the average e. m. f. on the lamps constant.

It is necessary, then, in working with alternate currents, to take into consideration the time retardation or lag of the current behind the e. m. f. We have seen that this lag is dependent on the resistance of the core, and on its degree of magnetization. I have found it especially necessary to make time corrections in work on alternate current motors, and in apparatus depending on the attraction or repulsion of magnets energized by alternate currents.

I have stated that there is no loss due to the periodic magnetization of iron cores by an alternating current. This is only true of a perfectly subdivided core. A solid core allows secondary currents to flow. Hence its storage capacity is lowered. In practice, the loss due to wasted currents in laminated cores can be kept as low as one per cent.

We may summarize the effects of retardation of currents behind the e m. f.'s in the induction coil as follows:

Retardation causes the counter e. m f. developed to have counter values inversely as the quantity of current flowing in the coil.

Retardation causes the energy expended in magnetization during the increase or development of a current to be returned as current energy during the subsidence of the current.

To an alternating or similar current, iron offers true storage capacity for all values of magnetization below the saturation limit.

Condensing Rain.

"I expect to see the sagebrush deserts of Nebraska and Nevada under cultivation and affording pasturage for thousands of cattle in a few years," said Dr. Cahill, of San Francisco, to a reporter. "Should the government adopt my patent, by its use there need not be an acre of waste land on the whole continent."

"By what extraordinary means do you intend to tap the clouds and interfere with the laws of nature?" queried the reporter.

"Simply by a condenser or captive balloon and an electric cable placed wherever the rain is required. I have long believed that rain could be produced by artificial means, and I have worked at this hobby of mine for several years, ever since I left college, in fact. You see, first of all, vapor, as it ascends receives heat from the solar rays, which also impels it upward until restricted by the cold. The vesicles or dewdrops being crowded together, become electrified and float on the air at an altitude of from 3,000 to 5,000 feet, and all that is required then to produce rain is to intercept these vesicles by artificial means. What I have invented is a condenser of peculiar shape and construction, and connected with the earth by an electric cable. Whenever the vesicles come into contact with the condenser or current they are broken up and the water forced to the ground with great rapidity. The rain will be produced by the same law as causes condensation on a window pane. The surface of the glass is covered with microscopic points, and on becoming chilled to the layer of air next it falls, allowing the vapor to flow on to the points and from thence to the ground."

"You will require a gigantic balloon for such a purpose," was suggested.

"Oh, no. A condenser of about 200 feet in diameter will bring down something like 25,000,000 gallons a day, or as much as would irrigate almost the half of this state. The volume of water can be devised or formed into rivers, which ever may be desired."

"What will be the cost of erecting and fitting up one of these condensers?"

"The condenser will be of specially prepared iron, and I have received an estimate from a well-known manufacturer, who places the cost at $2,500; another $500 would easily fit it up."

"What are the opinions of experts on the matter, doctor?"

"Well, when I brought my plan before them at first they were mostly skeptical, but I have got a great many of them around since. While in Washington I submitted it to the meteorological department, where I am well known, and to the heads of the geodetic survey, and both believed it to be practicable; indeed, the former body sent an indorsement to the secretary of the interior to have its efficacy tested."

A New Electric Railway System.

By W. E. Irish.

In many instances the introduction of electrically propelled street and other railroad cars, more especially the former, has been opposed in consequence of the obstruction and annoyance entailed by suspended conductors and supports necessarily employed in all overhead systems, and to the open channel left in the surface of the road necessary in most underground or surface systems. The employment of the ordinary traffic rails for the transmission of energy to propel the car is only applicable under specially favorable circumstances and on very short lines. The open channel system, to say the least, is far short of being perfect.

The overhead systems are impracticable in busy city thoroughfares, or where crossings and junctions are numerous. All the objections made to the three systems mentioned are met by the sealed conduit illustrated and described below.

The conduit represented in Figs. 1 and 2 is simply an elastic and water tight tube of soft rubber, containing within a continuous bare conductor to which contact may be made at any point within the tube throughout its whole length. Secured to the outside and upper surface of this elastic pipe are short rail pieces, flanged at their sides and breaking contact with each other. These rails are level with the surface of the roadway and are connected by means of screws passed through the rubber conduit to sectional contact pieces within the pipe, of the same length as the rail or surface sections. These contact pieces

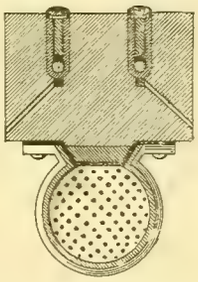


Fig. 1.—Irish's Sealed Conduit.

are also insulated by space and the rubber from each other. Screws metallically connect in pairs the surface rail sections outside, to the sectional contact pieces within the conduit. The flexible pipe fitted as described is placed in a suitable channel, formed in a line of timbers specially prepared, or in stone or metal troughs, placed in the center of the track between the ordinary traffic rails and flush with the surface of the road bed. Two such conduits are placed in the same line of timbers, in separate troughs, one tube carrying the outgoing, and the other the return lead or conductor. When the elastic tubes are placed in the troughs or channels, the elastic walls of the tubes support the inside contact pieces and the exposed sectional rails above and out of contact with the lead or conductor normally keeping the circuit open.

It will, of course, be understood that the main conductors or leads are connected to suitable stationary generators at some point near the road. The main leads in the bottom of the tubes are coupled in sections in suitable lengths by means of a variable expansion joint which will allow of their expansion or contraction under different temperatures without in any appreciable degree altering or affecting the electrical resistance. A sleeve is placed over the ends of the conductors where they meet, inside of which is a spiral spring which presses against the ends. These springs are compressed on the expansion of the conductors and elongated when the conductors contract, but at all times they make effective contact with the conductors and with the sleeve, as they offer less resistance than is offered by the same length of conductor.

The narrow contact wheel, Figs. 3 and 4, carried under the car near its center, presses upon the sectional rails as it arrives upon them, causing the sides of the elastic tube to yield until the contact pieces within the tube make contact with the main lead closing the circuit through the motor. When the pressure of the contact wheel is removed from a section by being carried forward, the sides of the tube will again open out or regain their former position, and lift the sectional contact piece out of contact with the main lead. The space between the sectional pairs allows of one section being depressed without interfering with the adjoining sections on either side, the rubber or wall of the elastic conduit being sufficiently elastic to admit of this. By this means and arrangement the loss of current by leakage is reduced to a minimum. The contact wheel and the track cleaner are secured to the same frame or turn-table, which is arranged to be reversed upon the car on its return journey or according to the direction of its travel. The frame may be raised or lowered according

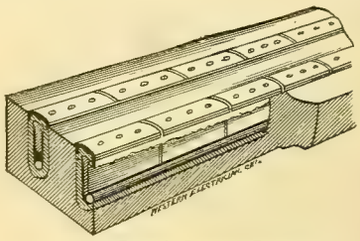


Fig. 2.—Irish's Sealed Conduit.

as the wheel is to be thrown into or out of contact with the rails. The method of operating can be clearly understood by reference to Figs. 3 and 4. The contact wheel is hung upon a pivoted frame on a shaft, on which it has some lateral play to adapt it to travel on a track that may be somewhat out of alignment, and the wheel has a concave tread which will enable it more certainly to keep the track. It is depressed by a tension spring with such pressure that as the wheel passes over the sectional track, it will depress the sections successively so as to bring the inside sectional piece in contact with the main lead, also within the tube. The two contact wheels on each car act alike in this particular, but run over and operate different conduits, one conduit carrying the outgoing, the other the return lead. These contact wheels are placed as far apart as possible. On the two contact wheels depressing the sections sufficiently to make contact with the leads through the sectional pieces, the circuit will be closed through the motor which is supported under the bed of the car, the screws connecting the short rails and the inside contact pieces being the medium for the passage of the current through the insulating pipe, and as one section is not cleared before connection is established through the next succeeding section by the wheels passing from one section to another, the circuit is continuous while the contact wheels are down, and

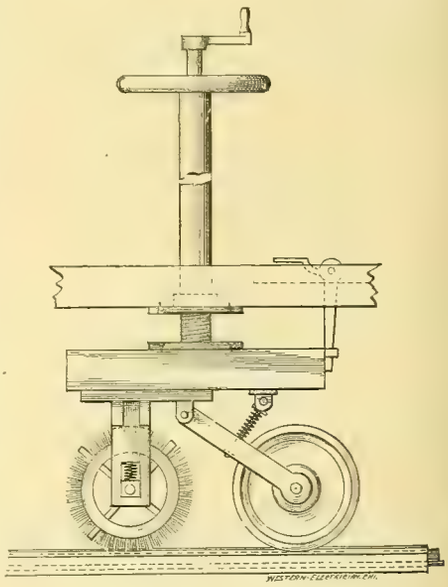


Fig. 3.—Irish's Sealed Conduit.

the circuit is not broken otherwise as by switch. As the sections are passed over by the contact wheels, the elasticity of the rubber carries them successively back to their original position.

In front of the contact wheel and supported on the same frame is a combined brush and scraper, designed to clear the exposed sectional rails of dirt, snow and other obstructions so that good

contact may be made with the rails. This combined brush and scraper is free to move laterally upon its bearings so as to conform to any divergence of the rail sections from a straight line, and vertically to avoid obstructions it can not remove. At intervals about its periphery and between the brushes proper, short metallic projections, which have concave working edges and serve as scrapers for the track, run in advance of the brushes and clear away the heavier obstructions. This wheel is not designed to rotate except to ride over obstacles that the scrapers can not remove, and the scrapers are so set with reference to the shaft that their resistance is opposite to the direction of rotation.

Fig. 5 illustrates a method of crossing a railroad track. It will be seen that it is simply necessary to carry the elastic conduits inclosing the leads beneath the cross rails, as shown, and then bring them up again between the rails until the other rail is reached when the conduits are again dipped. This enables contact to be made with the sectional rails between the tracks of a railroad crossing the system without material break in the continuity of the circuit.

In case a draw bridge or the like is to be crossed with the system, a second conductor, as a shunt in the main conductor, is run overhead or underground or submerged, as found most convenient. The conduit proper crossing the bridge as usual, but having spring contacts at each end of the bridge for connecting the mains when the bridge is open to car traffic. When the bridge is closed to car traffic, the circuit is maintained in every other portion of the system through the shunt conductor, which is permanently connected to the leads on both sides of the bridge.

Under the timbers carrying the railroad conduits a second conduit is secured,—Figs. 1 and 5,—consisting of a cylindrical iron tube having a V-shaped opening on top throughout its length, and lateral flanges by which it is bolted to the timbers. In this conduit telephone, telegraph, and electric light wires may be placed. It has a V-shaped covering underlaid by a sheet of packing, such as soft rubber, which extends laterally over the flanges and under the conduit timbers, sealing the conduit perfectly when the top is bolted down. By removing the top at any point the wires may be inspected or renewed without drawing in whole lengths of wires to replace one or two faulty ones, as is necessary in other conduits. This conduit may, of course, be used independently of the railroad system.

Fig. 6 is an automatic regulator. As shown, the tube is resting in a horizontal plane with a body of mercury in the center. The series of

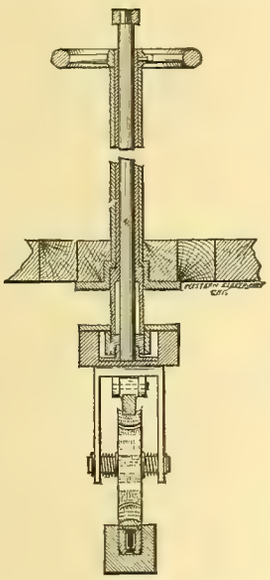


Fig. 4.—Irish's Sealed Conduit.

wires from the motor extend into the tube, those covered by the mercury being cut out of circuit, the circuit being only through those coils the ends of which remain uncovered or out of contact with the mercury. If the tube was tilted to the left, the mercury would flow and make connection with one set of contact points after another until, if carried far enough, the entire field would be cut out. On the other hand, the whole energy may be thrown through all the coils by making the extreme adjustment to the right and relieving the contact points of the connecting fluid. The tube is arranged on a car with reference to grades, and set in such way that when the car inclines, say forward as in descending a grade, the coils on the motor will be cut out, or resistance coils may be thrown in, the effect in both cases being a diminution of electric energy in proportion to the declination of the grade and the corresponding position of the mercury with reference to the contact points. The reverse of this would follow if the car were ascending a grade, in which case more electrical

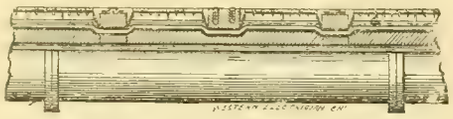


Fig. 5.—Irish's Sealed Conduit.

energy would be needed, and the coils on the motor would be thrown in, or the resistance coils cut out according to the elevation of the ascent.

The motor is supported under the floor of the car. It may be inspected and any portion easily renewed from the inside of the car. The armature coils are inclosed within the pole pieces in such manner as to make nearly the whole of the armature wire active. Two armatures are carried on the same shaft, the shaft being prolonged on both sides to carry the driving wheels which are situated midway between the car wheels on each side, the power being transmitted by connecting rods working eccentrically.

Electric Motors for the Spanish Navy.

Messrs. Immisch & Co. have just completed a very interesting electrical plant for the Spanish navy. The plant includes two 30 horse power, three 4 horse power, and one ½ horse power motors. The machines were all built to the specification of the Spanish naval commissioners, and were tested in the presence of three of their representatives. The tests showed that the contractors had fully discharged the conditions of the specification. The annexed tables give the figures obtained from one of the 30 horse power motors. The horse power given out was measured by a Prony brake. The diameter of the pulley was 24 inches, and the face 17 inches; the length of the arm of the brake was 63 inches. The brake was balanced so that it was only necessary to read the actual weight on the arm. The formula used was

$$\text{Horse power} = \frac{2\,\pi\, l\, n\, w}{33000},$$

where l = length of brake arm in feet, n = revolutions per minute, w = weight on arm in pounds. Putting $l = 63$ inches, we have

$$\text{Horse power} = .001\; n\; w$$

which is a very convenient form for calculation.

Speed.	Weight in lbs.	Volts.	Amps	H. P.	E.H.P.	Efficiency.
660	45¼	500	49	29.8	33	90
680	45¼	500	49	29.5	32.2	91
675	45¼	500	49	29.5	33	89

[The figures given are those observed and recorded by the Spanish naval commissioners.]

The resistance of the armature was .47 ohm, and that of the field .355. These resistances were taken when the machine had acquired the normal temperature for full output. The volts lost over the resistance of the machine were $49 \times .825 = 40.5$ volts. Therefore the theoretical possible efficiency of conversion was $\frac{459.5}{500} = 92$ per cent. nearly. The actual efficiency obtained averaged 90 per cent., allowing about 2 per cent. loss for mechanical friction, Foucault currents, etc.

The 30 horse power motors weigh 1,700 pounds. Each machine is fitted with a resistance frame, divided into three sections for starting. The reducing and make-and-break switches are so arranged that all the resistance must be put into the circuit before breaking; hence it is impossible to start without first running through the resistance. A large supplementary switch, with an extra long break, is also provided for use in conjunction with the reducing switch, or separately, in case of emergency. It is intended to run the motors from accumulators, and provision has been made to couple the cells in single series or two parallels, thus giving full or half speed on the motor shaft. The commutating switch used for this purpose is locked by the reducing switch in such a manner that it is only possible to change the coupling of the cells after the circuit is broken on the reducing switch. This obviates the risk of short-circuiting the accumulators. The direction of motion is changed by reversing the current in the armature. A sufficiently substantial switch is provided for this purpose. The brushes are of the Immisch, balanced, tangent type. The machines run very smoothly, and are practically sparkless.—*London Electrician.*

Compound Wound Dynamos in Multiple Arc.

Manager Stafford, of the Cleveland Electric Light company, Cleveland, Ohio, was in Chicago last week, and reports business very good. Regarding the question raised at a recent meeting of the Chicago Electric club as to whether there were any compound wound dynamos running in multiple arc in Cleveland, Mr. Stafford says that he has eight Thomson-Houston compound wound dynamos connected in multiple on the same circuits in his station and further adds that they work well.

A New Arc Lamp.

On the invitation of the chairman of the Maxim-Weston Electric company, a number of gentlemen interested in the subject of electric lighting visited the works of the company at Kingsland, London, yesterday, says the Glasgow *Herald* of November 29th, to witness in operation a small arc lamp which it is claimed will give five times the subdivision of light hitherto achieved by means of arc lighting. The lamp in question requires from 2½ to 3 amperes and 40 to 45 volts, giving about 150 candle power, so that six lamps of this power can be obtained from one electrical horse power. The invention consists in the arrangement of a series of wheels, levers, or other form of gearing for multiplying purposes, constructed on holders, frames or bearings, so that the mechanism shall be held in check by means of a brake placed in a part of the electrical circuit, so that the carbons when burning are perfectly controlled. In other words, the lamp is so constructed that when working the current of electricity shall pass through the brake in such a manner as to throw in and out of circuit wholly or partially the current; and, further, that the percentage of resistance shall be such as to prevent an undue shortening or elongation of the arc. It

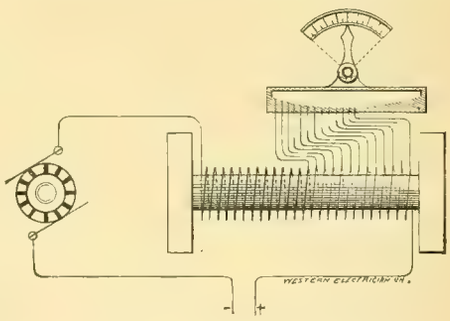


Fig. 6.—Irish's Sealed Conduit.

is claimed that by this means a steadier light will be obtained than by any known arc lamp, and also that the difficulty hitherto experienced in the lighting of large open or enclosed spaces, viz, the question of distribution at a low rate per lamp, will be overcome. It is estimated also that a large complete installation of the Watt dynamo and lamp will not cost more than one half-penny per lamp per hour, while the present arc lamps cost something like five times that amount. The lamp will be known as the Watt lamp, and the first batch of lamps are now in course of construction by the Maxim-Weston Electric company.

Western Electrician.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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THE Anglo-American Brush Electric Light company, limited, brought an action against Messrs. Crompton & Co. of London for infringing the Brush patent in regard to compound winding. Crompton & Co. brought a cross action for infringement on the Crompton-Kapp patent. Both suits have recently been settled, Crompton & Co. agreeing to judgment in favor of the corporation and accepting the usual license, and the Brush company taking an assignment of the Crompton-Kapp patent.

WE find it stated that the most economical way in which gas can be used as an illuminant is by its conversion into electricity by the intervention of the steam engine and dynamo. If this be true it is evident that the heating energy of gas is very largely in excess of its illuminating energy, since its conversion into electricity involves a heavy outlay and a considerable percentage of loss, and yet leaves an economic margin in favor of its outcome in electric light. We have not the facts and figures at hand, but it would seem that the advantage of the electric light as an illuminant, compared with gas, is approximately in the inverse ratio of its heat; and as the heat produced by gas in the warm season is one of the greatest objections to its use as an illuminant, and far in excess of that produced by the same quantity of illumination by electricity, the argument in favor of the electric light gains strength both as regards comfort and economy. If these are the facts the war between gas and the electric light is practically ended, and hereafter these opposing interests must become mutual friends.

OUR esteemed and able contemporary, *The Electrician and Electrical Engineer*, of New York, announces that commencing with the number for January, 1888, some changes will be made in its title and appearance. The sub-title, *Electrician*, will be dropped and the new title will be simply *The Electrical Engineer*. Paper of more agreeable shade will be used in the cover and we believe other minor changes are in anticipation.

Our contemporary will allow us to express the belief that the changes noted will be found to its advantage. A title as long as that now used is cumbersome to a degree, whether written in correspondence or spoken in conversation; moreover, the new title, in addition to being curtailed, is comprehensive and is an appellation that well fits the character of the periodical to which it applies; still further, it is a name which is distinctive and which will not conflict with that of any other paper in the electrical field at the present time.

The WESTERN ELECTRICIAN extends *The Electrical Engineer* hearty wishes for continued prosperity and the compliments of the season inaugurated by its first number under the new title.

AT a meeting of American Institute of Electrical Engineers in New York, November 15th, when the paper of Charles Cuttriss on recent improvements in apparatus for ocean cabling and Thos. D. Lockwood's note on the syphon recorder and ocean telephony were presented, Captain Trott of the Western Union company's cable repairing steamer Minia was called upon by the president who said that the captain was a very reticent man but was possessed of a wealth of information which, if imparted, would require a good deal of time for digestion. Captain Trott regarded himself as deterred by circumstances over which he had no control and did not yield much information. A member of the institute, however, ventured the question: "How deep can you grapple a cable?" and quick as a flash the characteristic reply came: "To the bottom, sir; but 2,600 fathoms is the deepest water that I have worked in." On another page of this issue a full description of the steamer and the methods of grappling for the ends of a cable in 13,000 feet of water is given, and will be of interest to those not familiar with the great difficulties encountered in this department and the means that ingenuity has provided to overcome them.

A PRESS dispatch of the 9th inst. from Pittsburgh, Pa., says: "Late Thursday afternoon a suit was filed in the United States circuit court which is the beginning of the litigation that is expected to settle the supremacy of the patents of the Consolidated Electric Light company over those of Edison. The action alleges that the McKeesport Light company is using electric lights and lamps which infringe upon the patents owned by the plaintiffs."

Since the announcement of the formation of the Consolidated Electric Light company a few weeks ago, the surmises as to when a legal conflict between the Consolidated and Edison companies over patents covering incandescent lamps would be inaugurated have been many. It was thought that sooner or later the Consolidated would enter the field against the Edison and that the struggle would be a strong one when once begun. Perhaps few of the uninitiated thought that war would be opened so soon but according to the foregoing announcement movements in that direction have been made. If the Edison company stands its ground there promises to be one of the sharpest legal fights on record. Both companies are very wealthy; and the enormous growth of the incandescent lighting business within a very few years and the prospects of the future make the control of fundamental patents, if there be such, a matter of weighty consideration.

THE New York *Graphic* in referring to a manual upon the "Commercial development of electric lighting in this country," recently issued by the Maverick National bank of Boston, of which Asa P. Potter is president, says "the book is interesting and instructive reading for some of the eminent bankers and financiers of the United States who from their lamentable ignorance of the subject have improved every opportunity to discredit electric lighting as a legitimate business enterprise. Mr. Potter is one of the most progressive and successful bankers in this country, and his opinion upon this or any other financial subject is worthy of the most respectful consideration."

If some of these decriers of the legitimacy of commercial electric lighting will come west they will doubtless learn more about business enterprise and commercial electric lighting than they ever knew before. They will find the electric light burning in hamlets, villages, towns and cities and a profit accruing to the stockholders of the companies which own the plants. They will find the electric light in great demand, and will find a large proportion of plants running to their full capacity and in many cases will find preparations for increasing those plants. They will find the larger electric light companies pushed to the wall to supply the demand for electric light apparatus and a general smile of satisfaction at the amount of business being done. May be they will meet an instance similar to one that came to the knowledge of the writer where an opportunity for a safe investment in real estate yielding eight per cent. for five years was laughed to scorn by an electric light man who added that "no eight per cent. investment was an inducement to any man in the electric light business.' Perhaps the statement will serve to open the eyes of those eastern eminent financiers who would jump at a chance to invest any amount of money at anywhere from four to six per cent.

OF REMARKABLY ingenious construction is the electrical conduit illustrated and described by Mr. Irish on other pages. A perusal of the article will show that extraordinary precautions have been taken to provide against those exigencies that beset modes of transmission of the electrical current to movable motors upon the surface of streets, and that a novel plan has been devised for crossing rivers where swinging bridges are used.

As a whole the system is new and original and presents one interesting solution of the perplexing problem that has faced electrical engineers in this direction. As such we commend it to attention.

IN this issue will be found an ably written paper on the phenomena of retardation in the induction coil by Wm. Stanley, jr., read at a recent meeting of the American Institute of Electrical Engineers in New York, which has a practical interest in connection with the transformers used with alternate current dynamos, by which current quantity is increased by the inductive action of a coil of high resistance on one of low resistance.

The points made by the writer, and which he proves by physical and mathematical demonstration, are:

1. That retardation causes the counter e. m. f. developed to have counter values inversely as the quantity of current flowing in the coil; that is, the counter e. m. f. decreases as current quantity increases.

2. That retardation causes the energy expended in magnetization during the increase or development of a current to be returned as current strength during the subsidence of the current; the energy absorbed by magnetism during the increase being stored up and returned as current during the decrease.

3. To an alternating, or similar current, iron offers true storage capacity for all values of magnetism below the saturation limit, and hence it is highly important that the iron core of the transformer coil should have the lowest possible resistance to prevent saturation, and should be laminated to avoid heating and Foucault currents. In this way the loss due to wasted current can be kept as low as one per cent.

INTEREST in the copper market continues unabated among large users of bare copper wire. The prospect for an increased price, as noted last week, has been realized and instead of 20 cents which was the price that ruled a week ago Monday, the price had gone to about 22 cents last Monday. But Tuesday a new aspect was put upon the market by the direction of one of the largest wire drawing companies to its agents in Chicago not to make any prices or to take any orders except subject to the acceptance of the company. The feature of the metal exchange in New York Monday, was the dealings in copper, 500,000 pounds of lake copper changing hands. For December the quotations were $17.20 to $17.45, for January $17.25 to $17.50, and for February $17.65, showing confidence in the future of the market. The condition of the Calumet & Hecla mine—the output of which is placed at about two-thirds of the entire production of the Lake Superior district—has awakened attention. A representative of that mine who was in Chicago last week said that the fire which had been raging for three weeks could not be gotten under control in another three weeks. Smaller mines in other parts of the country have taken advantage of the rise in price brought about by the restricted production and have resumed operations. But no effect seems as yet to have been made upon the market.

Copper men are jubilant at the prospect. It is claimed that they have been doing little more than exchanging old dollars for new ones for some time and that low prices should and will be a thing of the past.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number XXII.

Electric Measurement.—Instruments for electric measurement are constructed either on the principle of electric attraction and repulsion, on the relations between electricity and magnetism, on the heat developed by the electric current, or on the amount of metal deposited or gas generated by electrolysis. Those constructed on the principle discovered by Oersted, that the magnetic needle tends to assume a position at right angles to the direction of the electric current, are known as galvanometers, and are chiefly used to measure battery currents, while those constructed on the principles of

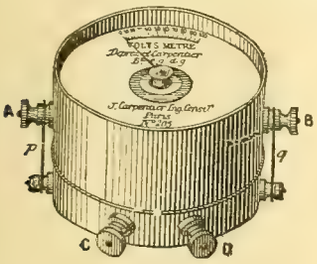

Fig. 53.

electrolysis are known as voltameters and are used to measure the electromotive force of batteries. But the powerful currents and great e. m. f. developed by the dynamo has led to the invention of instruments of special construction, known chiefly as voltmeters and ammeters; voltmeters designating those which measure electromotive force, the results being given in volts, and ammeters those which measure current strength, the results being given in amperes. Ammeters are also called current meters and ampere meters. There are also instruments of special construction designated as electro-dynamometers, colomb-meters and ohm-meters.

It is evident, that since current is derived from e. m. f. and resistance, if two of these three quantities are known, the third can easily be found by one of the following formulae,

$$(C=\frac{E}{R}),\ (E=CR),\ (R=\frac{E}{C})$$

so that only two instruments are required, which are usually the voltmeter and ammeter.

There are also instruments known as potential indicators, which do not measure e. m. f., but are arranged to indicate deviations above or below a certain normal e. m. f., and are placed permanently in the circuit, like the steam gauge on the boiler, as a guide to the engineer or attendant, while measuring instruments are used chiefly in making tests.

The Potential Indicator.—Figure 52 shows a potential indicator used by the United States Electric Lighting company; a well-known form, it is constructed on the principle of the electric motor, or reversed dynamo, current producing motion instead of motion producing current. Two horse shoe magnets with consequent poles, placed horizontally, as shown, form the magnetic field in which is placed the armature, shown at the center; the armature core is a cylinder of soft iron laminated, placed vertically in a fixed position. A helix of fine copper wire, wound on a copper ring and placed vertically also, surrounds the core, but is insulated from it, an air space intervening between them. This helix is suspended by a fine phosphor-bronze wire attached below to the base of the instrument and above to a screw with a milled head, connected to a short arm projecting from a vertical support. A long pointer projects towards the front and is bent downwards at right angles over a scale, which indicates, to the right, five volts above, and to the left five volts below a certain normal e. m. f. indicated by zero; each of the numbers, 10, 20, 30, 40, 50, indicating about a volt and each volt space being subdivided into tenths, as shown. The instrument is enclosed in a glass case and supported on leveling screws. The instrument has a very high resistance, and is connected directly between the positive and negative leads at the point where the electric pressure should be kept constant. In other words, the instrument is connected in multiple arc or parallel between the points whose difference of potential is to be measured; the resistance being very high, only a very small fraction of the current will pass through it. The armature helix is connected in series with the field magnet coils, as in the series dynamo; and the current causes it to rotate round its core so as to move the pointer over the scale from left to right in opposition to the torsion of the wire by which it is suspended, current producing motion as stated above. The torsion is so adjusted that the required e. m. f. brings the pointer to zero; hence its movement to the right of zero shows that the e. m. f. is too high, or to the left, that it is too low. By an increase or decrease of torsion the normal e. m. f. can be varied within certain limits.

The Deprez-Carpentier Voltmeter.—This instrument, shown by Fig. 53, is constructed with two C-shaped, permanent magnets, placed with their similar poles facing each other, between which is suspended a soft iron needle, having a free horizontal movement, and surrounded by a coil of copper wire, or ribbon, whose terminals are connected with the binding posts A and B. This coil being composed of a large amount of fine wire has a resistance of 1,800 to 2,000 ohms. A pointer connected with the vertical axis, to which the needle is attached, moves over a scale, graduated from 0 to 100 in volts, as shown. The instrument is placed, in a derived circuit, between the terminals of the main circuit, so that the current passes through the coil. When no current is passing, the needle is held in a fixed position by the attraction of the permanent magnets, the pointer indicating zero; but when the current passes, the needle is magnetized, and its poles being repelled by like poles of the permanent magnets, and attracted by unlike, it rotates in proportion to the e. m. f. or difference of potential in the dynamo, which is indicated in volts on the scale. Hence the instrument depends on the principle of the electro-magnetism produced by the current opposing permanent magnetism, the latter tending to bring the needle back to the fixed position while the former causes it to recede. The instrument

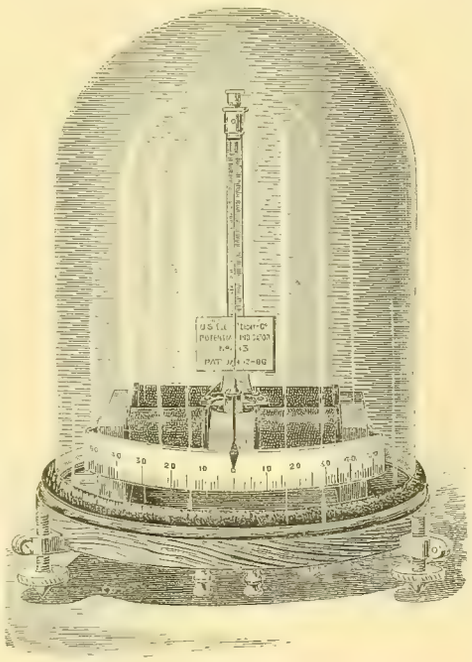

Fig. 52.

must be accurately adjusted before being put in use, and as permanent magnets become weaker with age, remagnetizing and readjusting are required from time to time.

The movements of the needle are "dead beat," that is free from troublesome oscillations; the high resistance of the coil reduces the derived circuit to a measurable strength, while the loss to the main current from this short circuit is but slight. The instrument is inclosed in a cylindric case 4 4-5 inches in diameter and 2 2-5 inches in height, and has a glass cover. The shunt is inclosed in a separate case, placed underneath, as shown: the connections with the main circuit being at C and D, and those with the shunt at *p* and *q*.

The Deprez-Carpentier Ammeter.—This instrument, shown by Fig. 54, is similar to the voltmeter, and constructed on the same principles; but as it is generally placed directly in the main circuit its coil has low resistance, to avoid heating and material increase of resistance; and hence it is composed of a few turns of thick copper wire. Its scale is graduated from 0 to 50 in amperes. It is also provided with a shunt which may be used if required, the resistance of which has a definite ratio to that of the ammeter; this is inclosed in a separate case underneath, as

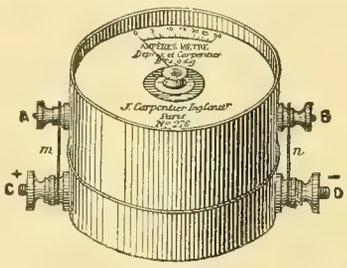

Fig. 54.

shown, and connected in parallel with the ammeter coil; the main current entering the shunt at C+ and leaving at D—, while the other branch passes through the ammeter from C+ by *m* A B *n* to D—. A portion of the current being thus diverted through the shunt reduces that portion passing through ammeter, and the resistance of the shunt being known, the full strength of the current can easily be ascertained. This instrument, like the voltmeter, is "dead beat" in action.

It will thus be seen that the difference between a voltmeter and an ammeter consists in difference of resistance and difference of position; the voltmeter having high resistance and being placed in a derived circuit between the points whose difference of potential is to be measured while the ammeter is of low resistance and is placed directly in the main circuit, the current which passes through it passing also through the lamps. These principles apply to various other styles of these instruments now in common use.

Electricity and Meteorology.

The local office of the United States hydrographic bureau is furnishing some interesting reports on marine phenomena and meteorological displays, says the New Orleans *Picayune*.

Electric globes or aerial fire balls constitute some of the rarest and most peculiar forms of lightning. A globe of fire floats leisurely along in the air in an erratic sort of a course, sometimes exploding with great force, at other times disappearing without exploding. On land it has been observed to go into the ground and then reappear at a short distance and where it entered the soil it left a ragged hole some 20 feet in diameter. Although there is no doubt as to the facts regarding the phenomenon, no satisfactory explanation of the cause has ever been given. It is, of course, entirely different in character from St. Elmo's fires, so often seen on board vessels during thunder storms; these remain stationary at the yardarms and mastheads, and are analogous to the "brush discharge" of an electric machine. Captain Moore, of the British steamship Siberian, reports: "November 12th, midnight, cape Race bearing west by north, distant 10 miles, wind strong south by east, a large ball of fire appeared to rise out of the sea to a height of about 50 feet, and come right against the wind close up to the ship. It then altered its course and ran along with the ship to a distance of about one and a half miles. In about two minutes it again altered its course and went away to the southeast against the wind. It lasted in all not over five minutes. I have noticed the same phenomenon before off cape Race, and it seemed to indicate that an easterly or southeasterly gale was coming on."

The *Picayune* has repeatedly urged the importance of investigation to determine if elec-

tricity plays any part as a factor in producing the atmospheric changes, which are commonly known as "weather." The meteorologists without exception have entirely neglected this branch of their science, some of them going so far as to visit with supreme contempt any suggestion that electricity is anything more than a mere result of weather causes. But here is a shipmaster who has observed that this globular electricity foretells easterly gales when seen off the coast of Newfoundland. If visible electric phenomena can give warning to a practical sailor, it may be possible, all the philosophers to the contrary notwithstanding, that the invisible but constantly present electricity, so subtle and yet so potent, may have much to do as a "weather breeder."

To day the laws of weather changes are so little known that it is impossible to foretell even for a few hours in advance what is coming to pass in atmospheric phenomena. When a particular change has actually commenced at a given place, the progress of the movement by means of the telegraph may be determined and reported, but the weather philosophers are totally incapable of predicting for any period in advance the advent of storms, of hot or cold weather or of droughts or of excessive rains.

If meteorology as a science were on a line of advancement with many other branches of physical philosophy, it might be possible to foreknow weeks and months in advance the character of the coming seasons with all their peculiarities of weather. Unfortunately for the philosophers, they have not improved on the methods and instruments used in their observations since they were invented a couple of centuries ago. Our weather science is but little in advance of that of the dark ages.

Grappling an Ocean Cable.

One of the marine novelties of the world that on rare occasions comes into this port is now lying at a dock in the Erie basin, says the New York *Sun*. The novelty is the steamship Minia, Captain Samuel Trott, a vessel built and used for making repairs to the Atlantic telegraph cables belonging to the combination under the control of the leading men in the Western Union Telegraph company. To a spectator on the dock the Minia would scarcely attract attention as a marine novelty. She is neither large or small, her length being 328.5 feet, breadth 35.3 and depth 25.1. She is rigged as a top sail schooner. and she measures 1,986 tons gross. The one feature likely to attract the eye from the deck is the appearance of three big grooved iron wheels, side by side, just where the bowsprit projects from ordinary ships. A look about the deck and down some of the hatches, however, shows a number of peculiarities.

The Minia came here about four weeks ago, in order that she might repair certain injuries received about the rudder when engaged off the banks of Newfoundland in repairing a break in the Brest-St. Pierre line of the Anglo-American cable. The damage to the vessel was inconsiderable, for she was able to finish the repairs to the cable before coming here, but the details of the work of picking up the ends of a broken cable and splicing in a new piece, as related by one of the officers of the ship, are interesting. To one not familiar with the work the sending of a ship to pick up the end of an inch wire rope 13,000 feet beneath the surface of the sea seems very much like a wild-goose chase, but once the plans are understood it is simple enough, though somewhat tedious at times, not only to find the ends, but to pick them up and splice them to a new piece.

The break which the Minia was sent to repair occurred early last summer. The officers of the company first located the distance of the break from the stations on shore on each side of the ocean. The details of the instrument by which this is done are not easily described, though easily understood in principle. The machine consists of a series of coils of wire, which offer a known resistance to the electric current. Enough of the coils are connected to make a resistance equal to the resistance offered by the entire cable when it is in working order, and thus when the machine and the cable are connected a balance is effected. But if the cable should break, the balance is destroyed, because that portion of the cable between the shore station and the break, wherever it may be, will offer less resistance to the electric current than the entire cable would do. Enough coils of wire are therefore disconnected from the machine to restore the balance. The resistance of the part of the cable that remains intact is thus accurately determined by the number of coils remaining connected with the machine. Having, when the cable was intact, learned the resistance which a mile of the cable offers, by dividing the entire resistance by the number of miles of cable, it is easy to find how many miles of cable are still in good order by dividing the entire resistance of the piece by the known resistance of one mile.

This explanation may be a little complicated to one not fond of mathematical demonstrations, but it is just as the Minia's officer made it, and it is remarkable for its lucidity when compared with explanations which electricians generally make. It is noticeable also from the fact that the word ohm, the name of a unit of electrical energy and the bugbear of everyone who does not know anything about electricity, is wholly omitted.

Having determined how many miles from the shore station the break is, orders are sent to the Minia, to go to the place, pick up the ends, and splice them to a new piece. Having received such an order and acted on it, Captain Trott found himself and his ship, on July 25th last, in latitude 42° 30′ north, and longitude 46° 30′ west, or just to the eastward of the Grand Banks of New Foundland, with one of the hardest jobs before him that he had had in some time, for sounding showed that the water was about 13,000 feet or a good deal more than 2 miles deep. He knew he was somewhere near the break in the cable, but he did not know absolutely within about three or four miles, because while he had been able to determine his own position by repeated observations of the sun and stars, he could not tell how accurate the observations of the officers of the ship laying the cable had been.

The first work done was to get a series of soundings over a patch of the sea aggregating twenty-five or thirty square miles. The sounding apparatus consisted of an oblong shot of iron, weighing about thirty-two pounds, attached to a piano-forte wire in such a way that when lowered to the bottom the shot would jab a small steel tube into the mud down there and would then release itself from the wire and allow the sailors to draw up the tube with the mud in it. The moment the weight was released the men on deck stopped paying out the wire, and thus knowing how much wire had been run out, they were able to tell the depth. It is an interesting fact that it took twenty-four minutes and ten seconds for the weight of the sounding apparatus to reach bottom in 2,097 fathoms of water.

Having learned the depth of water and the character of the bottom, a big black pear-shaped buoy was put overboard and moored about where the end of the broken section ought to have been, according to the calculations. The buoy is made of boiler iron and is arranged to support two large white lanterns at night, for the work is carried on day and night, when the weather will permit. This buoy is kept from floating away with the tide by an anchor that looks like an open umbrella. Secured to the anchor which was put over was a 45-fathom section of chain; above that 510 fathoms of patent rope, invented by Captain Trott, and consisting of part steel wire and part hemp strands. It is designed for both strength and buoyancy. Then came 1,101 fathoms of pure manila rope, and above that enough of mixed wire and fibre rope of different kinds to reach the surface and secure the buoy.

The ship was now ready to begin the search proper for the cable. She was run off at right angles to the line of the cable for a distance of five miles and a buoy got down to mark the limits of the territory to be grappled over in that direction. Buoys were afterward set elsewhere to mark the other limits of the territory. The grappling iron was lowered over the bows, the rope attached to it passing over one of the three big grooved wheels that revolve where the bowsprit of an ordinary vessel stands.

The grappling iron used is the invention of Captain Trott. It looks something like a four-pronged anchor. It has a shaft four feet long, and four arms about a foot long that are set at right angles to each other at the bottom of the shaft. Right in each crotch formed by the arms is a little button that has a spring behind it that may be regulated in strength. The button projects a third of an inch into the crotch. The angle of the arms with the shaft is so small that a rock could not get down in so far as to reach the button; but when the cable is caught by the hooks it presses down against the button, and thus closes an electrical circuit through a copper wire running through the grapnel's rope and the grapnel itself, and a bell is set ringing upon deck. But the experienced men in charge of the grappling are generally able to tell what the hook has hold of without the aid of the bell. They judge by the strain on the rope which is indicated by a dynamometer on deck. The ordinary strain on the dynamometer is from 3 to 3¼ tons when the grapnel is dragging freely over a smooth bottom as the vessel forges slowly ahead. Sometimes a rock catches on the hooks. This frequently breaks off an arm, but sometimes it fetches clear, the strain indicated by the dynamometer informing the old sailor man in charge whether an accident has happened or not.

It took two hours and twenty minutes to get the grappling iron from the bow of the ship down to the bottom of the sea, 13,000 feet below. The cable used to drag it with is the patent wire and hemp invention of the captain. The dragging began on July 25th, the day of arrival, but they swept backward and forward over the territory for ten days without finding the broken telegraph cable. A good part of the time they were steaming back and forth day and night, and the only time they were not doing so was when the weather was too bad. On such occasions they went to the buoy at the supposed end of the broken cable and hove to till the gale was ended.

Finally, on Aug. 5th, the bell rang, indicating that the grapnel had caught the cable. The grapnel drag rope was thereupon fastened to a buoy and thrown overboard. Then the steamer went off two miles toward the end of the broken cable and got out a cutting grapnel. This is like the other one, except that there are knives in the crotches. When these crotches catch the cable and a strain comes on them, they cut the cable off clean.

"Why did you cut off the cable there?" was asked.

"Because if we had tried to get up the bight of the cable where we first found it, the cable might have broken under the strain. That cable was laid in 1869, and is getting pretty well along in years. It would have been as apt to break on the shore side as the other, but when we had only an end of two miles to deal with, we were sure of being able to get it up without damage. We grappled the European end first."

Having cut off the cable, the vessel returned to the buoy of the grappling rope, and getting the rope inboard again, led it to a drum six feet in diameter, located on the upper deck and operated by a steam engine. Then they began to wind in the grapnel rope and hoist the old cable to the bows. They started the drum at 1:20 in the afternoon of Aug. 5th and at 7:51 had the bight of it at the bow of the ship. Then the two miles and odd of end that was hanging down from the bow, was fished up and stretched in lengths along the deck until the end was reached. This was connected with a very complete cable telegraph office located amidships, and a second later the operators, who had been on watch for days in the British station, awaiting this event, saw the flashes in a mirror in their office, that told them all about it.

Sometimes it happens that when an end of the cable is picked up in this way and an attempt is made to communicate with the shore, it is found that there is another break, and that they have only an end of an odd section lying loose. Then they have to drop that over, after testing it to see how long it is, and go on toward the shore and begin over again. In this case, however, they found that they had hold of a sound wire to Great Britain. Without any delay, the end of a new cable was spliced to the old end brought from the bottom. Two experts, one who is trained in splicing cores, and one who is trained in splicing the outside or sheathing, are employed in this work.

When the splice was completed and tested and found perfect, the cable was started running out around drums and grooved wheels controlled by brakes, and over the stern, the old end having been led fair through these shieves before the splicing was done. Then the ship headed for shoal water and ran away at from three to four knots an hour until over a part of the banks where work could be done more easily than where the water was more than two miles deep. Of course this involved the abandonment of a good many miles of old cable, but the old cable wasn't of very much importance anyhow.

Arriving in shoal water the end of the new piece was attached to a buoy and put overboard. Then the old cable was grappled and cut as before and a new piece spliced to it. Then the ends of the two new pieces were spliced together and the job was complete. It had taken nearly two months to do it, although in the mean time two easier jobs were attended to and a trip to Halifax, for provisions, was made, not to mention the encountering of the storm that damaged the rudder.

The Minia has a crew of 90, all told, including the captain, three deck officers, a navigator, three expert electricians, four engineers, a purser and a surgeon. A blacksmith and a boiler maker, with their tools, are carried. There are three big, round tanks to hold the 600 miles of cable carried, which includes sizes to fit all the old cables under the charge of this ship. There is a cell room where the electricity for telegraphing is generated, and two dynamos with their engines, one to furnish electricity for a system of arc lights used when at work at night, and the other for the incandescent system that lights the ship below decks. The main saloon is large, and is comfortably and handsomely fitted. The captain has a cabin under the turtle back aft, as fine as any captain could wish for, and the other officers have rooms below that are as well fitted as those usually occupied by naval officers. The crew are all expert men, and get pay that averages a good deal better than the pay in the packet service between New York and Liverpool. The entire crew is kept under pay the year round, the ship making her headquarters at Halifax when not engaged in repairing cables. They are as comfortable a lot of sailor men as one could find anywhere.

A curious fact in connection with the immense amount of grappling done by this ship and the great number of samples of the bottom brought up by the sounding apparatus, is that the only products of human ingenuity ever raised by either grappling iron or sounding apparatus were two anchors of modern construction and one sample of ashes, evidently from some steamship. It is said that enough sailors have been drowned between New York and Liverpool to pave the bottom of the sea from port to port, and that enough fishermen have gone down on the banks to cover them three feet deep; but no human remains have ever been brought up either by this ship or by any other dredger. Neither have any remains of the thousands of ships that have been wrecked in that region been encountered. What becomes of these wrecks and the bodies of the lost sailors is a mystery which the officers of the Minia have not been able to solve. Certainly, they say, if either remained intact on the surface of the sand at the bottom of the sea, either the grappling iron or the sounding apparatus in passing and repassing thousands of times over a part of the ocean where the wrecks are most numerous must bring up proof of their presence there.

An Alarm for a Secondary Battery.

Our London namesake describes a simple form of alarm which is intended to be used with secondary batteries when either the charging or discharging current exceeds the proper limit. The principle adopted is that of the thermic alarms, which depend for their action upon the bending of a compound metallic plate under variations of temperature. In this case a strip or plate, consisting of two metals rolled or soldered together, has a narrow slit cut in it almost, but not quite, from end to end, thus forming a narrow, flat U-piece, the ends of which are rigidly held and connected to terminals, which are placed in the main circuit. The closed end of the loop is free to move, and carries a carbon stud. Immediately opposed to this is a similar stud, to be connected through an ordinary electric bell to one of the cells in such a manner that when the two studs make contact, the current from one cell only will pass through the coil of the bell. The distance between the two contacts is adjustable. The tendency of the current in passing round the loop is to cause the free parts carrying the contact stud to bend upward, and should the prearranged limit be exceeded, alarm is immediately given by the bell, which may be fixed at a distance if required. The alarm is found to be practically constant and reliable, variations in the temperature of the atmosphere being inappreciable in effect.

An Electric Dice Table.

For ten years past there has stood in the corner of the billard room of the principal hotel of this town a rickety old card table, writes a correspondent from Hanford, Cal., to the St. Paul *Globe*. Its worthlessness caused it to remain in the place during the changes of the hotel's many proprietors It was a round table covered with an old gray army blanket, tacked to the edge through a long strip of leather. At regular distances were four pieces of tin clumsily nailed down for the players to lay their cigars on. In late years its four rudely-made legs were so shaky that no one cared to teeter his chips on the table, and it was chiefly used by the guests to throw their coats and hats on when they went to their meals.

For a long time the present proprietor always said when he looked at the table that he "intended to clear it out to-morrow and get a new one," but somehow this was not done until lately; perhaps then only because people began to tear their coats on nails, and their impromptu remarks on the subject tended to complicate matters.

It was after a double-barreled explosion of this kind the other day that the proprietor told his bartender to cut the cover off the table and make kindling wood of the cussed thing. He had just made one savage slash and had started a second, when his knife struck against something metallic. He then ripped the cover off and found a steel plate nine inches long and six inches wide which was set flush into the table. The plate was about a foot from the edge and pierced with a dozen holes.

Everyone wondered what it was for, and an old townsman remembered that the table had been brought there from Virginia City years ago, and presumed it was used in the early days to play some kind of cribbage. When the table began to be chopped up a light was thrown on the character of the table, for underneath the top, concealed on a little shelf by one of the legs, were a small battery, coils of wire and some complicated machinery connected with one of the tin plates. These were covered with rust and dust.

Then the old townsman woke up and remembered seeing in days gone by a man named Pick Davis win $7,000 at dice on that very table from a cattleman in about fifteen seconds, besides picking up sundry thousands and hundreds at other times from those who were gamblingly inclined.

Two drinks also caused him to suddenly recollect that Davis came down to Mussel Slough—as Hanford was called then—from Virginia City with a big reputation as a "dip chuckler," and the boys came from far and near to buck him.

It was said that Davis had won over $100,000 at dice in the mines, where he was called "Lucky Pick." As he was not found out in his play, he is alive to-day, but he has changed his name and owns a big ranch in the San Joaquin valley. So it is seen that one way to wealth and respectability has been for a "sure thing man" in the discovering of a magnetic outfit to do up people with dice and not get caught because he got in his work single-handed.

The afternoon of December 13th a fire broke out in the four-story brick building at Park avenue and Hall street, Brooklyn, N. Y., occupied by the Consolidated Electric Light company and burned out the upper two floors. The loss is estimated at $60,000.

CORRESPONDENCE.

New York Notes.

NEW YORK, Dec. 10.—The assembly telephone investigating committee resumed their work in New York on Wednesday of this week, and four days have been spent in examining the officers of the New York & New Jersey Telephone company and the Metropolitan Telephone & Telegraph company. Some of the points of interest made public are as follows: The New York & New Jersey company has a capital stock of $2,400,000, $800,000 of which went to the Metropolitan company for a perpetual franchise, this franchise covering all of Long Island and the state of New Jersey within a radius of thirty-three miles from New York city. The average number of subscribers for 1886 was 5,317, and the average rental value was about $67.72 per subscriber. The average number of local calls per day on the company's entire lines was five per subscriber. The dividends paid have averaged $101,647.05. The net earnings for the year ending December 31, 1886, was 7.74 per cent. The company has recently made a contract for a new multiple switchboard for Brooklyn at a cost of about $16,000. The Metropolitan Telephone & Telegraph company was organized in 1880, with a capital stock of $1,000,000, which has since been increased to $2,000,000, and provisions made for a further increase to $5,000,000, to provide for placing the wires underground. The stock is owned by the American Bell Telephone company and the Western Union Telegraph company. The number of subscribers averaged last year 6,106, and the average general business rate in New York city is $150. On the first of January the company had 5,916 miles of wire and 102 miles of poles. The gross earnings to May 31, 1887, were $6,484,111 05, and the net earnings $2,507,869.85; $745,000 have been paid in dividends. The company is refitting its exchange with a new Western Electric multiple switchboard and the cost of improvements will amount to several hundred thousand dollars. The committee will continue their work next week.

New York bay is full of spar buoys, and it is probable that all of them will soon be lighted by incandescent lights of about thirty candle power each. Experiments under the direction of Lieutenant Willis, of the light-house department, have proved very successful, and he states that such lights are practicable and very desirable. He has contracted for 2,000 feet of submarine cable for the purpose of lighting at once the buoy number 18, near Robbin's reef light-house, in the upper bay.

Elmer E. Wood was instantly killed at Canandaigua on the evening of the 4th inst. by a dynamo current. He was manager of the Canandaigua Electric Light company, and received the shock while trimming a lamp. He dropped unconscious to the ground and was dead when picked up a moment later. The only mark upon him was a small black hole in his thumb.

The Newark common council are considering the question of ordering the electric lighting companies to place their wires underground. Alderman Connolly has urged the adoption of such a measure, on the ground that it will abate the pole nuisance and will improve the quality of the lights.

At Asbury park the commissioners of the borough have ordered the Seashore Electric Railway company to furnish iron poles within twenty-one days or else forfeit the franchise under which the road is operated.

New Rochelle will soon be lighted with arc electric lights. The trustees have appropriated $11,000 and will contract for seventy lights for one year.

The talk of a new telegraph line between Boston and San Francisco arouses an old-timer to a story of an experience of his in the building of the first line across the plains: One pole, 100 miles west of Laramie, was set up four times and each time hacked down by Indian tomahawks. Each time there was a bloody skirmish with the redskins for temporary possession of the stump. At last the pole was given to a young man who is now high up in the management of the Western Union. He laid a mine in the hole, set up the

new pole, trailed the fuse to an ambush of rocks close by and waited with two armed friends. Then a band of eight Sioux came along and held a war dance around the pole. When the mine was fired all but three were killed and those three carried off minie balls with them. The powder blew up the pole again, but it cleaned the hole out nicely for a new one, which was thereafter let alone.

Charles W. Brega, a stockholder in the Commercial Telephone company, has begun suit against the directors of the company, asking that their action in increasing the capital stock be reversed, and that several transactions of the directors, which he alleges to be against the welfare of the company, be set aside.

A meeting of the stockholders of the Stock Quotation company was held this week and the following officers elected; William G. Hurst, president; Eugene Durvin, secretary; William H. Crawford, treasurer; J. J. Walsh, general-manager, and A. G. Hummell, superintendent.

The Edison Machine works have not been long in the market as manufacturers of insulated electric wires and cords, but they have already found that they can have their hands full in helping to supply the demand for goods of this class. James F. Kelley, general sales agent of the company, recently closed an order from a large supply house which included 85,000 yards of incandescent electric light cord.

The Bishop Gutta-Percha company, are putting in a new engine and are doubling their capacity for the manufacture of wires with high insulation. They expect to have the new plant in operation by the first of January. A.

Lighting the Hoosac Tunnel.

Boston, Mass., Dec. 10.—When the great Hoosac tunnel, near North Adams, was built, it was thought that a shaft sunk from the top of the mountain to the center of the tunnel would prove a great ventilating chimney, which should keep the great bore free from smoke. The 1,200-foot chimney has partially failed of its purpose. Under certain conditions the smoke accumulated in the tunnel and would not leave by any of the exits. This accumulation, coupled with the darkness, has made the work of inspection and repair exceedingly difficult to the gang of men constantly employed in and about the tunnel. Constant watching of the walls, and of the track and road-bed are more necessary even than a like inspection of the outside mileage of the Fitchburg railroad. It has been an expensive work to the railroad company, for with its section gang of 100 men employed in the tunnel, but two thirds could do active work, the other third being required as torch holders. Even with so large a number of living lamp posts the work of the section hands was both slow and dangerous.

With a view both to economy and safety, then, the directors of the Fitchburg Railroad company have decided to put a system of incandescent electric lights through the entire length of the four and three-quarters miles of tunnel. Placed as these lights will be, 40 feet apart on each side of the wall of the tunnel, and alternated so that there will really be but 20 feet between each light, it is thought that there will be a sufficient illumination to enable the section gang to perform the work of inspection and repair much better than they have done it in the past. In fact, during the trial tests made over a half mile of track during a period of several weeks, the experimental tests were thoroughly satisfactory. So well was the tunnel illuminated that a person riding on the rear platform of an express train moving at the rate of thirty miles an hour, could readily distinguish one section hand from another as the train rushed by.

The illumination of the tunnel has brought up some novel questions in the problem of electric lighting. It was found that the metal sockets ordinarily used with incandescent lights would not answer, and other material had to be employed. The gas and smoke was found to exert a powerful corrosive effect upon the metal. Chemical action and dampness has therefore to be contended against and the greatest care exercised in order to protect the main line and its connections. To accomplish all the objects desired the electricians of the Westinghouse Electric Light company, which is to supply the plant, have adopted a novel plan. Two V-shaped wooden boxes have been sunk in the loose stone ballast on the outer sides of the double-tracked road-bed, just outside the ends of the ties. Each of the boxes will contain four heavy copper wires, making eight wires in all, running through the entire length of the tunnel, in all nearly forty miles of wire. Small connecting wires are tapped into the main wires at intervals of forty feet on each side, to carry the current to the lamps affixed to the side walls of the tunnel, some 1,300 in number. These connections will be properly insulated to prevent corrosion, and it is believed that an absolutely perfect system of lighting can thus be obtained.

The material to be used in the lighting of the long tunnel is now being collected, and the entire system will be in readiness for use in a few weeks. The experiment will be watched with much interest as a means of solving the question of lighting subterranean passages, one that has been much discussed of late. Electricians are confident that it will prove a success, and so, of coarse, must be the directors of the Fitchburg road, or they would not have tried it. C.

From the Pacific Slope.

San Francisco, Cal., Nov. 30.—At the meeting of the board of trustees of Stockton, Cal., it was decided to use electric lights only for city lighting, and to receive bids for 100 lights on a two years' contract. C. R. Lloyd, representing the Indianapolis Jenney system, put in a bid of $16,500 per year and received the contract. This plant is to be of 200 light capacity—102 lights for city purposes and the rest for commercial use. Natural gas can be secured in the near future by a short pipe line, but petroleum will be used for the present for fuel.

Work on the electric road at Stockton will be begun inside of thirty days and the road will be completed in a year, according to contract with the city.

The Pacific Coast Steamship company will have incandescent lights put in all of their steamers that are not already provided with them.

The Canadian Pacific R. R. is about purchasing three steamers to put on the line from Victoria, B. C., to China. Officials say the steamers will be fitted throughout with incandescent lamps.

Dr. Rea has proved that by the use of electricity in mining all fine gold and mercury can be saved, and now almost all large mills are using dynamos for that purpose.

A year ago an incandescent plant was put in at the coal mine of the Oregon Improvement company, at New Castle, W. T. It has shown a saving of over $350 per month and has proved a far superior and safer method of lighting. As coal is a scarce article on the Western slope just now, men must be kept at work all night cleaning coal in the bunkers. Since the New Castle mine has adopted the glow lamps there has been no complaint about dirty coal from this mine, consequently R. A. Simon has been ordered to put incandescent plants in the coal mines of the company throughout that territory.

The mines at Virginia City, Nev., are all being lighted on the surface by arc lights and the owners are now preparing to take the incandescent lights down below into the workings.

A new substance for making carbons has been discovered in California in the shape of a mineral that does not waste away as the present carbons do.

One of the most interesting and complicated pieces of mechanism in connection with the telescope at the Lick observatory on Mount Hamilton—the largest telescope in the world—is the great driving clock, set just beneath the telescope head within the upper section of the tube. It is governed by a double conical pendulum and regulated by electric connection with the standard sidereal clock of the observatory. The pendulum balls weigh 125 pounds and make one revolution per second. By an ingenious system of mechanism the driving clock is so connected with the polar axis of the telescope that the great tube, when pointed to a star, is made to move backward as fast as the earth moves forward in its diurnal motion, thus counteracting the motion of the earth and making the star appear to stand still in the center of the field of the telescope. Access to the driving clock and balcony is gained by a spiral staircase at the south side of the column. The center of motion of the instrument is thirty-seven feet above its base. When the telescope is pointed to the zenith the objective glass will be sixty-five feet above the base. The whole telescope complete weighs 65,000 pounds. So perfect are the details of its construction, many of them being invented by the manufacturers, that the colossal instrument can be used more conveniently and rapidly than many smaller instruments.

The Western Union and Postal Telegraph companies are renting all the small offices and corners that they can possibly get for branch offices in this city.

D. D. Wass, electrical engineer, who was appointed an expert by the Alameda city trustees to examine the lighting plant at that city, reports everything in first-class order and recommends that a complete set of test instruments be added to the plant. Mr. Wass is superintendent of construction for the Electric Development company on the Pacific coast. S.

Noblesville, Ind., Gas Fields.

Noblesville, Ind., Dec. 10.—The mention of the natural gas fields of Noblesville made in your columns will bear elaboration. Gas was first struck here last January, and the first well is one of the four that are now furnishing the heat and light for this city,—a place of about 4,000 population. It has given a great stimulus to the growth of the city, and more improvements have been made the past season than for ten years previous, and a great deal more will be done next year. The city offers free gas to manufacturing establishments and has already secured an edge tool works. Work on this building, as on several others, progresses just the same on cold days as on any others, as winter is virtually turned into summer by large flames of gas, so that workmen work comfortably in their shirt-sleeves. Other establishments are in view. The gas here has been found to be the best for heat and light of any yet discovered. There are now twenty-eight wells in this field, and more are drilling, the average depth is about 875 feet, and all are dry wells. Some of them can be heard roaring for several miles. Several are larger than the Karg well at Findlay, O.; probably the largest is the Wainwright "wonder." O.

Cincinnati Chat.

Cincinnati, O., Dec. 10.—During the performance of "Michael Strogoff," at Robinson's Opera house at a matinee Dec. 1st, James O'Connell, stage manager, was instantly killed by an electric shock, which also badly injured Charles Christy, a stage hand. An examination of the wire leading to the arc light in the proscenium arch revealed a defective insulation, making a connection with the metal speaking tube which led to the prompter's stand. O'Connell got into the circuit by resting his hand on the zinc-covered box from which the gas burners are controlled and received the full force of the current. The sad affair occurred almost in in sight of his affianced wife, Nellie Collins, a member of the company. O'Connell's home is in Chicago, where his remains were shipped. Christy's hands were badly blistered as if by intense heat. C.

Detroit's Budget.

Detroit, Dec. 10.—For the third time has the mayor vetoed the awarding of the lighting contract to the Brush company. His reasons are substantially the same as those stated heretofore, viz: That there was no competition, and that the price asked was exorbitant. His investigations led him to believe that the cost should not exceed 30 cents per light per night, while the city now pays 55 cents. Proofs were numerous, to show that the price the city would be compelled to pay, if the contract was awarded as

proposed, was largely in excess of what many other cities are paying. The mayor attached to his veto a proposition from the New York Electric Construction company, offering to put in a plant similar to the present one, operate the same and light the city for the next three years for $338,000, taking its pay monthly as the Brush company is now paid, and at the expiration of three years sell the plant to the city for $50,000. Under the conditions of this offer, at the expiration of three years the city would own its own plant at a cost not exceeding the sum paid the Brush company for the same time under the conditions of the proposed contract. This much-vetoed contract now lies on the table where it will probably remain until the majority has the requisite number of votes to pass it. The question of the city owning its own plant, however, has become popular. So much so, indeed, that two committees are now in the field for the purpose of investigating the matter—the aldermanic committee and one appointed by the citizens at a meeting held Monday last. The aldermanic committee expect to report in about thirty days.

C.

From Indianapolis.

INDIANAPOLIS, Ind., Dec. 10.—Judge Taylor, of Fort Wayne, concluded a three days' argument in the Brush-Jenney electric light case before Judge Gresham, December 8th, and he is credited with having made a great legal effort. C. C. Mitchell, of Woolwich, Conn., began the closing argument on the morning of the 9th

C.

THE ELECTRIC LIGHT.

The Thomson-Houston Electric Light company of Baltimore city has been incorporated, with a capital stock of $200,000; S. H. Taggart, G. R. Berry, J. D Mason, H. B. Hanna and Chas. Angle, incorporators.

There is soon to be launched at the yards of the Detroit Dry Dock company a large car ferry boat which is to ply between Mackinac and Point St. Ignace. The boat will carry ten freight or eight passenger cars. An electric light plant is to be placed in the boat and a 2,000 candle power light will be fastened on the pilot house by a universal joint so as to be turned in any direction, to be used as a search light.

L. D. Snook is negotiating for the erection of a Brush Electric light plant at Fernandina, Fla.

At St. Cloud, Minn., the Gem Electric Light company has petitioned the council for a franchise to light that city.

T. E. Blanchard and others have asked for permission to erect an electric light and power plant at Columbus, Ga.

The plant of the Belvidere, N. Y., Electric Light company has been sold to George F. Wiley, of Philadelphia.

The Amsterdam, N. Y., common council has decided to erect sixty-seven arc lights of the Thomson-Houston electric system in the streets. The cost is $6,683.25 per year for sixty-seven lights of 1,200 candle power each.

The San Rafael, Cal., Gas company has determined to add an electric light annex to its present plant. It is expected to complete the work of construction by January 15th.

The Pulaski Gas company of Little Rock, Ark., contemplates the erection of an electric light plant.

October 25th a car load of electrical apparatus was shipped from Indianapolis for the Alameda, Cal., plant. Its non-arrival delayed the improvements and additions under way. Recently a search was made for the car by the railway authorities and it was found switched off at Santa Fe.

The Nickerson, Kan, electric light plant is in operation.

Washington, Ind., is happy over its electric lights.

The largest independent electric light installation in Spain will be that of the Royal Italian opera house. There will be about 1,500 incandescent lamps, and a dozen arcs.

The Thomson-Houston company has just taken a single contract for 600 arc lights at St. Paul, Minn.

The town of Albacete, Spain, which has a population of about 20,000, and which has hitherto been lighted by oil, is adopting the electric light for private and public lighting, 16 candle power incandescent lamps being employed.

A new theater was opened last month at Odessa, Russia, in which special precautions have been taken for safety from fire. The auditorium, which accommodates 1,800 persons, can be entirely separated from the stage by an iron curtain which can be lowered in from fifteen to twenty seconds. The auditorium is heated by hot air, and the remainder of the building by hot water. The theater is entirely lighted by electricity, the dynamos and engines being situated a mile distant. Water is laid all over the theater; in the lower parts it is supplied direct from the town reservoirs, and in the upper parts from three iron tanks on the roof, which are fed by a steam pump. The stage, which accommodates five hundred people, is not only separated from the auditorium by the iron curtain, but also from the back premises by automatic iron doors leading into fire proof corriders, which in their turn are also separated from the dressing rooms by iron doors. The flooring of the whole building is made of iron.

THE ELECTRIC MOTOR.

The electrical section of the Brussels exhibition of 1888 has invited proposals for laying down a tramway line similar to that in the Jardin d'Acclimation, at Paris, the cars to be drawn by electric motors, supplied from accumulators. Two kinds of tram cars will be used: Small automotor cars for ten or fourteen passengers, containing the batteries under the seats, and the motor under the car itself; and ordinary tram cars, two of which are to be coupled together and drawn by a special electric locomotive, which will contain the accumulators and motor. The electrical and electric lighting sections are under the charge of M. Ch. Mourlon, with M. Bandsept as resident engineer.

The electric motor line to old San Diego is now running successfully five miles, and the use of the steam motor has been discontinued.

Steps have been taken in Pittsburgh, Penn., toward chartering the National Electric Railway company.

THE TELEGRAPH.

Jardin, Mathersin & Co. are finishing the laying of two cables for the Chinese government. The first of these submarine cables goes from Amoy to Tamsin in the island of Formosa, and the second from Aminy on Formosa to the Pescadores islands. The cables were made by the Silverton company and the laying has been done by the ship Fee Chen, of the Chinese navy. The Grand telegraph company of the northern and eastern telegraph announce on their part that the isle of Formosa has been placed in communication with the telegraphic network of China by means of a cable via Foochow. Offices have been opened at Tamsin, Keelung and Taipchfoo.

A report from London says that Jay Gould has stirred up a lively rumpus among his English coadjutors in the cable pool by demanding better terms for the Western Union Telegraph company than are now accorded it. Officers of the Western Union company decline to discuss the report, but Russell Sage said there was some foundation for it, though he did not look for anything like a dissolution of the cable pool. He believed concessions would be made to the Western Union company.

The *Fort Worth Gazette* is responsible for the following: "The telegraph offices in California have printed on blanks for the use of emigrants; 'Send me a ticket home and $6. Flat broke.' Customers have only to put the address and signature on these, the receiving clerk stamps the date on them and funnels them up to the operating room"

The bill introduced by Mr. Edmunds into the fiftieth congress, providing for a postal telegraph system, is similar to the measure introduced by him in the last congress. It provides that four trunk lines of telegraph, connecting Washington with the four sections of the country, shall be arranged for by a board consisting of the secretaries of state and war and the postmaster general; that the employes shall be government officials and subject to civil service rules. The sum of $2,000,000 is appropriated for the first year.

Cable dispatches from London the 12th announced the confirmation of the report that the French government would refuse to allow the French Cable company to continue in the cable pool, and that in consequence it had withdrawn.

Arrangements have been made by T. L. Vandenberg, superintendent of the telegraph lines of the Southern Pacific company, by which every point on the Pacific coast can be informed the precise moment the last spike of the California and Oregon road is driven. Colonel C. F. Crocker will wield the hammer by which the spike will be driven. Wires running north to Portland and south to Sacramento and San Francisco will be connected with the hammer, so that when the blows are made on the spike, which will be attached to the wires also in all towns on the coast, where arrangements have been made, the electric spark can be utilized to ring bells and fire guns, announcing the precise moment of the completion of the great route to the northern coast. The spike will be driven by three blows, made at intervals of ten seconds. The telegraphic circuit will be closed by each blow. The operators along the line will reply each time a blow is made. After the third blow has been given the word "done" will be transmitted from Ashland to all points, thus notifying them of the completion of the ceremony. Superintendent Vandenberg has also sent out instructions to have all weather reports forwarded to him at Ashland early in the day, so that he may know just what provisions to make for the successful telegraphic transmission of the accounts of the ceremonies.

The New York *Times* recently received a cablegram of 18,000 words, 10,000 of which came over two cables of the Commercial Cable company. The matter was received at the rate of 17 words a minute and it kept both cables busy for about five hours.

THE TELEPHONE.

Warren Anderson, of Xenia, O., superintendent and general manager of the Miami Telephone company has accomplished what would hardly have been considered possible three weeks ago. He has built up the Lebanon telephone exchange until there are about forty subscribers and more boxes to go in.—*Lebanon Gazette.*

Robinson (in his office)—"Yes, the telephone is a great invention, Brown. I wouldn't be without mine for four times what it costs. There's a call now. Just listen and you will see how distinctly one can hear." Voice (clearly and distinctly)—"Your telephone rent is six months overdue. Unless the amount is paid to-day it will be taken out."

Miss Theresa Brennan, manager of the Englewood telephone exchange of the Chicago telephone company, was notified Friday of last week that she was co-heir with her sister to $30,000 left them by an uncle. The money has been on deposit in a bank in Ottawa for seven years, and it is calculated that each sister will receive $25,000 in cash.

NEW ENTERPRISES.

Calvin Moore of 2403 Wyandotte street, Kansas City, Mo., is about to erect a business block of ten houses, which will be provided with electric bells. The estimated cost is $40,000.

George Eystell, druggist, of the same city, will put up a $4,000 residence, in which electric bells will also be placed.

A syndicate, of which Jarvis Conklin & Co., brokers, of Kansas City, Mo., are members, will put up a club house in that city at a cost of $40,000. It will be furnished with a fire alarm, electric bells and all the latest improvements.

Galesburg, Ill., is to have an opera house to cost $25,000. A. A. Matteson will be the owner. It will be lighted by electricity and everything going to make up a first-class opera house will be put in.

The Second National bank of Aurora, Ill., Alonzo George, president, will put up a new bank building at a cost of $10,000.

A stock company is about to build a $200,000 cotton factory at Janesville, Wis. It will be lighted by electricity. Herman Clauson, of Afton, Wis., is interested.

The Des Moines Packing company of Des Moines, Ia., is about to put up a large packing house.

A soldiers' orphans' home is to be built at Knightstown, Ind., by the state. A. H. Morris is the superintendent.

Miscellaneous Notes

A new accumulator under the name of Tudor is now being introduced in Brussels. The distinctive feature consists in the employment of a grid with a thin central web by which greater rigidity is given to the plates. The active material is pressed into the holes of the grid from both sides, but to insure its adherence the plate, before receiving it, by charging and discharging is oxidized, which, according to the inventor, causes the material to adhere much better.

The mercury which, in Sprengel's air pump, traverses the apparatus for the liberated air to pass off carries on its route small quantities of air, which form bubbles in the siphon of the pump. When these bubbles come in contact with the glass they burst and render the vacuum less perfect. Dr. Bottomley, says *Electricite*, has invented a combination of the Sprengel pump and the ordinary pump of Geissler, in which the mercury passes off without coming in contact with the air. The movable reservoir is furnished with a hermetical stopper, permitting the expulsion of the air of the reservoir and preventing its return. In practice the apparatus operates first as an ordinary Geissler pump until almost all the air has been expelled from the space where it is desired to create the vacuum. Rapidity of exhaustion is thus gained by the Geissler pump. When a sufficient vacuum has been obtained, the stop cocks of the movable reservoir are arranged to open as a Sprengel pump, and the traces of air which may remain are carried away by the vacuum chamber of the Geissler pump; when this chamber has been filled with a sufficient quantity of air it can be removed by a single operation of the Geissler process. Dr. Bottomley has in this manner obtained a vacuum of 1-30,000,000 of an atmosphere, according to the gauge of Mr. Leod, but the exactness of this apparatus has been doubted.

Experiments with the Achard electric brake have been made on the French state railways during the last few years. An improved form has been used, the improvement consisting in the fact that the electric current is not employed directly in working the brake shoes, but is employed to form an electro-magnet in a friction apparatus which hangs in a box near the brake axle. The action of the current causes the electro-magnet to be attracted by the axle which by friction sets in rotation a drum around which a chain winds. The other end of the chain is attached to the brake lever. The electric current is generated by a dynamo on the locomotive.

The investigations of a society formed in London to abate the smoke nuisance affords a rather startling idea of the wasteful extravagance of the present system of combustion. Here is a summary of a late report of the Smoke Abatement institute: The weight of the smoke cloud over the city is estimated at about 50 tons of solid carbon and 250 tons of hydrocarbon and carbonic oxide gases. From actual tests, the value of coal annually wasted through the obstinacy of the Cockneys is £2,257,500, or 42 per cent. of the amount annually expended for coal in London, that being the percentage of heat that escapes up the chimney without warming anybody. This waste also causes a useless expenditure of £268,750 for carting coal, to say nothing of the wear and tear of streets, and of £43,000 more for carting away ashes. Altogether about £2,500,000 are yearly thrown away in London. Add to this £2,000,000 for injury to property from the smoke-laden atmosphere, and there is shown a total of £4,500,000 which London annually loses because of its failure to burn coal under proper conditions.

A test of a new electric train signal was made on the Boston & Maine road at Boston, Dec. 3rd, and was successful in every particular. The main feature of the system is the coupler connecting the device on different cars. This consists of a band rubber casing, with interlocking metallic flanges, inside of which the entire mechanism is located. In the center of each coupler is a catch, backed by a stout spring, which unites with a similar catch on another coupler. On each side of this catch is a phosphor-bronze sliding rod, and when the two parts of the coupler are brought together the rods in each come in contact, and the open circuit is completed. The electricity is generated in a battery placed in the engine cab, bnt the Acme Railway Appliance company, which owns the coupler patent, also claims to hold the exclusive right to generate its electric power by a dynamo operated by steam from the locomotive.

A New York dispatch of the 9th announces that a lawsuit is threatened between Dr. Bell and Thomas A. Edison over the phonograph.

"About all of the photographs taken in the depths of the sea are by experimenting amateurs, and through them most marvelous hidden mysteries have been revealed," says Mr Schleler in the Nashville *American*. "Until the plate is seen, they have not the slightest idea of what has been photographed. The operation, however, is simple. A box, hermetically sealed, with glass front, is sunk, and to it is connected an electric light. At a certain depth light fails to penetrate the water and all is darkness. Sinking this device to within a short distance of the bed the electric current is turned on, which illumines everything within a certain radius, and at the same instant calls into action the mechanism of the submerged camera. Often, to be sure, almost nothing appears upon the plate, but sometimes the instrument is lowered among most interesting formations of nature, and pictures are produced of incalculable value to science. These experiments are constantly being made, and are such that those connected with the art as myself can not possibly prosecute."

Before the board of alderman of Providence, R. I., at a recent meeting, Elias E. Ries demonstrated that, by the use of his electrical apparatus designed to increase tractive adhesion, a street car could climb the 14 per cent. grade on College hill.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	390
Central Union	44	45
Michigan	76	77
Great Southern	30	32
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	28	30
Missouri and Kansas	68	69

Personal Paragraphs.

Norman McCarty, representing the Baxter Electric Manufacturing & Motor company, of Baltimore, Md., passed through Chicago last week.

Charles D. Wright, of Kingman, Kan., was a recent guest at the Chicago Electric club. He is in charge of a Heisler incandescent and a Thomson-Houston arc plant.

Business Mention.

Curtis & Wheeler of Rochester, N. Y., and the P. Cox Shoe Manfg. Co., of Fairport, N. Y., last week ordered engines of the automatic high speed type of the Woodbury Engine company of Rochester, N. Y. The one for Fairport will run an Edison plant. This engine for electric light purposes is destined to take the lead. Its perfection of detail, and its close regulation under varying pressures and changes of load make it an engine peculiarly well fitted to the exacting demands of electric light men.

The Baxter Electric Manufacturing & Motor company of Baltimore, Md., are doing a most satisfactory business with their arc motors. They have 1,500 horse power in use and their sales for two weeks past have aggregated more than 175 horse power.

The Edison street lighting system at Jerseyville, Ill., of 600 lights, has just been put in operation. It was installed by Leonard & Izard of Chicago.

Leonard & Izard of Chicago have just closed a contract for 225 Edison lights in the shops of the Minneapolis & Pacific railroad at Minneapolis.

The Western Electric company has just taken a contract for a 45-light plant at Fort Benton, M. T., and a 20-light plant for the Chicago Forge & Bolt company, Chicago.

The American Illuminating Co. of Augusta, Ga. has become a financial success and its officers write in the most positive terms regarding its success, notwithstanding another company has entered competition by building an opposition plant. Mr. Dutch, president of the Augusta company was in New York recently and ordered another 100 light plant from the American co.

Electrical Patents.

Issued Dec. 6, 1887.

374,164. Apparatus for Covering Wire with Soft Metal J. Charles Appleby, Jersey City, N. J.

374,166. Apparatus for Covering Wire with Soft Metal. J. Charles Appleby, Jersey City, N. J.

374,173. Apparatus for Converting Heat Energy into Electrical Energy. Willard E. Case, Auburn, N. Y.
The elements consist of a tin and mercury amalgam, and carbon. They are placed in a cell containing chromic chloride liquid.

374,198. Contact Brush. Edward L. Orcutt, Somerville, Mass.

374,199. Rail Connection for Electric Railroads. Edward L. Orcutt, Somerville, Mass.

374,224. Incandescent Electric Lamp. Marshall Wheeler, Boston, Mass.

374,225. Electrical Dental Engine. George W. Whitefield, Evanston, Ill.
A clutch operated by an electro magnet is caused to engage with the driven shaft to stop the same instantaneously when circuit is closed through the said magnet.

374,236. Electric Railway. Edward M. Bentley, New York, N. Y.

374,315. Conduit for Cable or Electric Railways, William Nier, Kansas City, Mo.

374,322. Signal for Engines. James C. Ricketson, Milwaukee, Wis.

374,329. Galvanic Battery. Henry E. Waite, New York, N. Y.

374,348. Underground Conduit for Electrical Conductors. George W. Cook, Detroit, Mich.

374,374. Electric Governor. Willis H. Reynolds, Washington, D. C.

374,381. System of Electric Distribution. Montgomery Waddell, New York, N. Y.
The invention relates to the Edison System of Electric Lighting, and is designed to enable leaks, crosses or ground connections to be located.

374,390. Telegraph Transmitter. Arthur Bixby, Baltimore, Md

374,404. Regulator for Electric Currents. Stephen D. Field, Yonkers, N. Y.
The invention consists of an electrolyte contained in a suitable receptacle having conducting plates immersed therein connected with the circuit, which plates are preferably made of non-oxydizable material with a non conductive plate, which is adapted to be interposed between the conducting plates to any extent desired so as to cut off the current entirely or to interpose as much resistance in the circuit as required.

374,406. Regulation of Electric Generators. Daniel Higham, Philadelphia, Pa.
The claim is as follows: An electric generator having its field magnet coils and armature coils in series in the working circuit, in combination with a short circuit around said series, field magnet coils, and an electro-magnetic circiut breaker in the working circuit to close the said short circuit.

374,439. Transmitter. Reuel W. Whitney and Frederick Pultz, Cleveland, Ohio.
The device shown is a supplemental funnel-shaped mouth piece placed in front of a telephone transmitter. A wire gauze diaphragm is placed in the funnel about an inch from its smallest end so as to come near the diaphragm of the telephone. There are five claims, the first of which is "An independent mouth piece for telephone transmitters, provided with a articulated or perforated diaphragm for diffusing and equally presenting the sound waves, substantially as specified."

374,444. Printing telegraph. Arthur Bixby, Baltimore, Md.

374,456. Galvanic Battery. Frank J. Crouch, Eugene City, Oregon.

374,458. Underground System for Electric Wires. Joseph P. Davis, New York, N. Y.

374,495. Coin Operated Induction-Coil. William R. Pope, Baltimore, Md.

374,528. Electric Gas Lighter. Justus B. Eutz, New York, N. Y.

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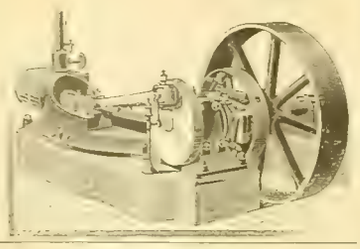

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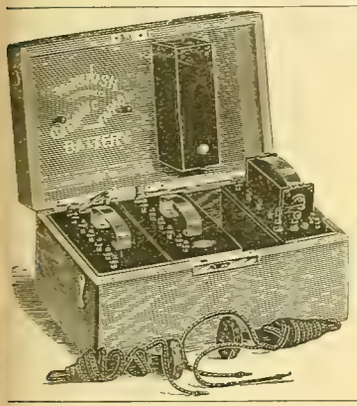

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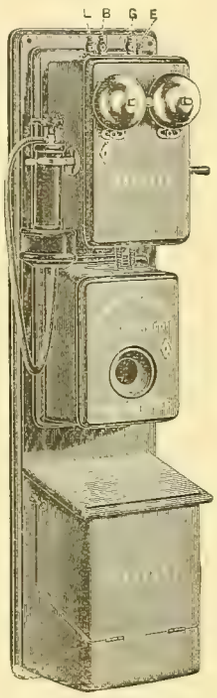

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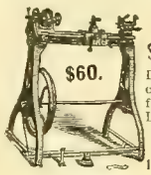

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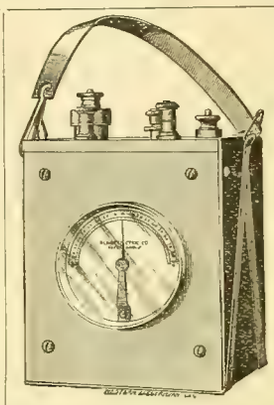

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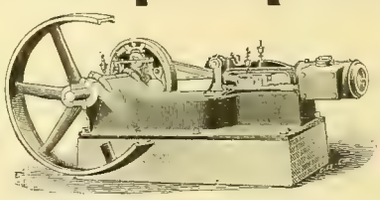

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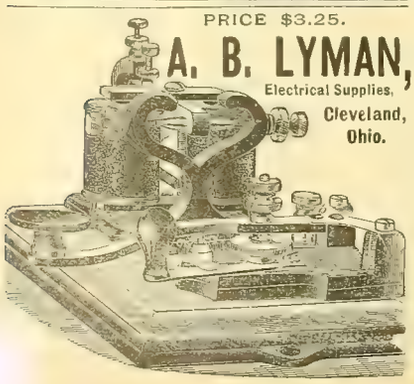

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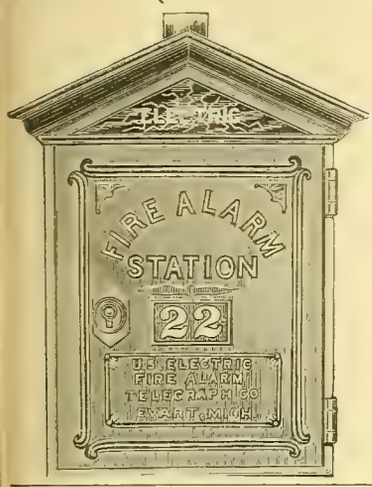

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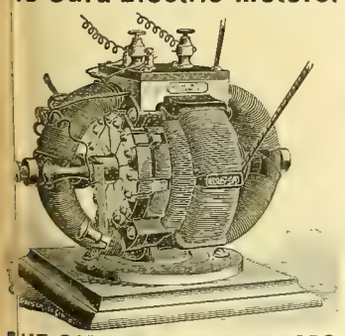

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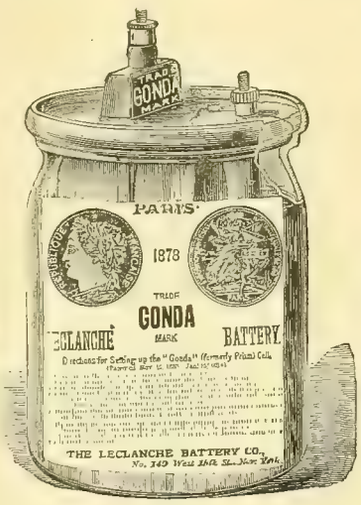

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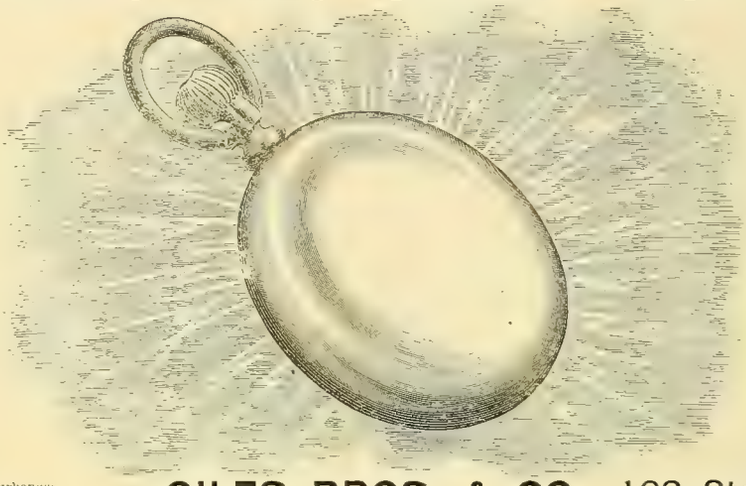

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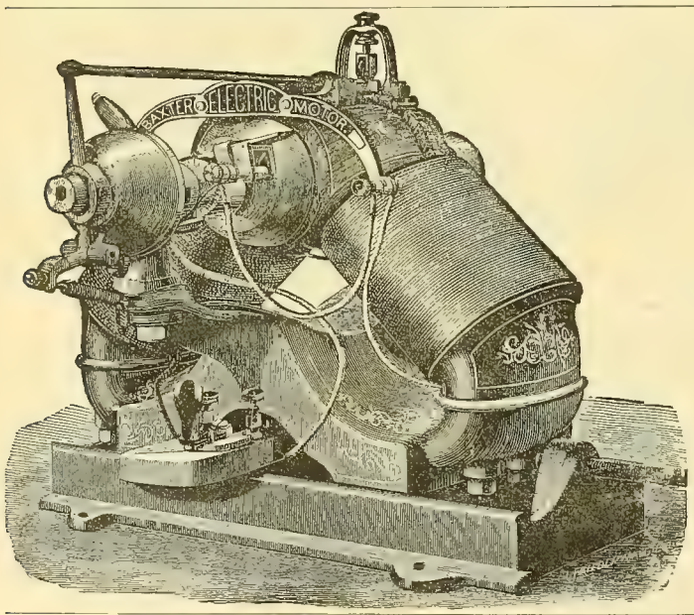

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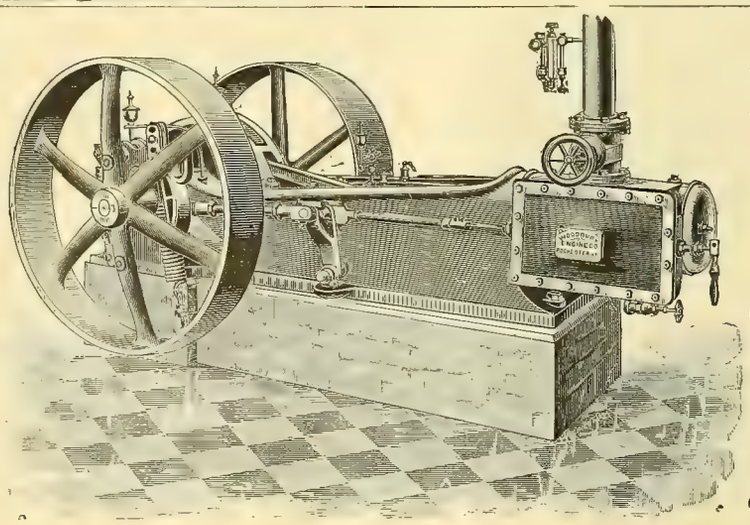

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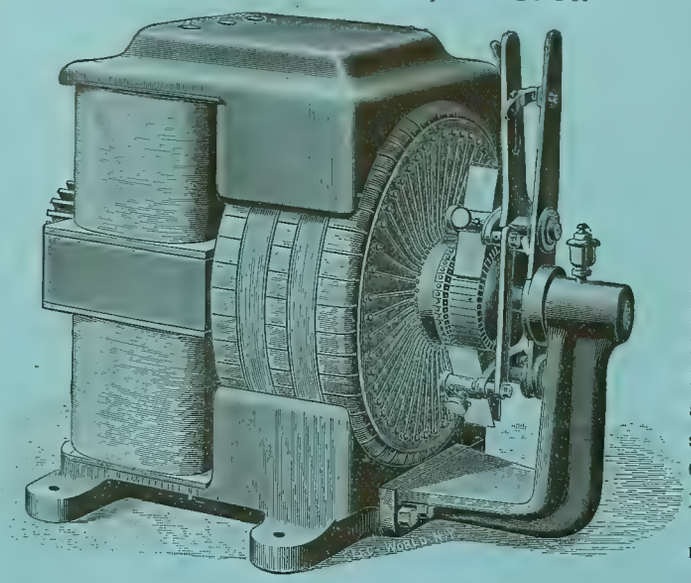

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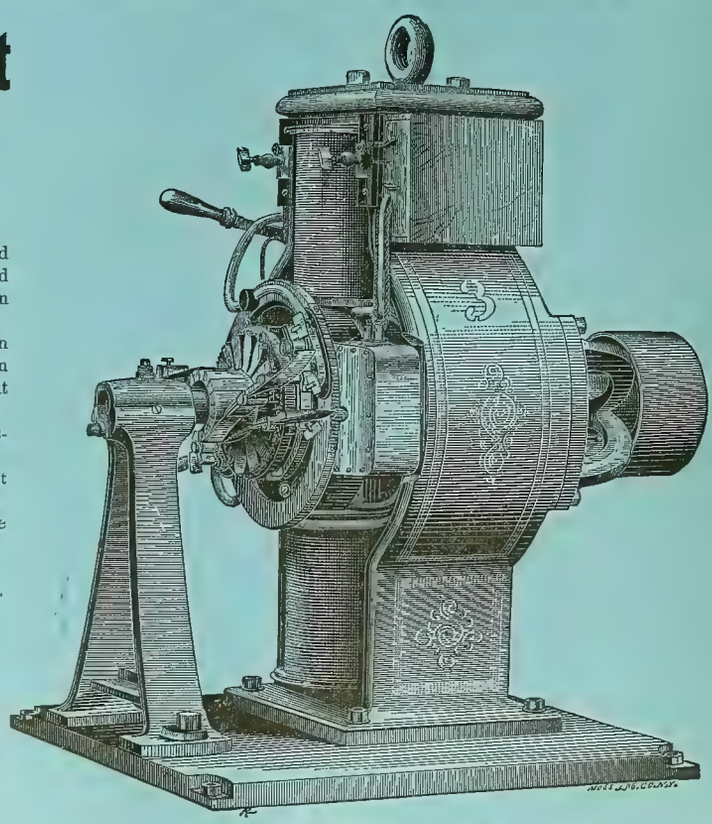

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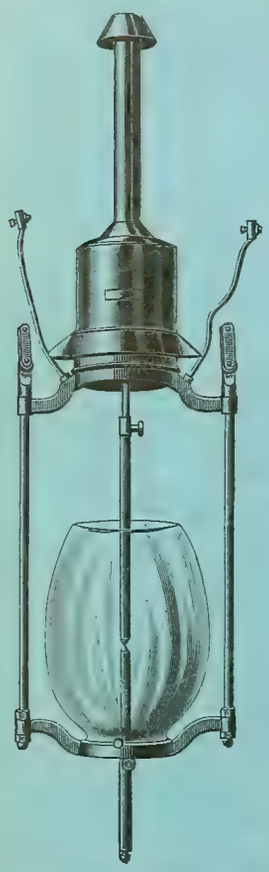

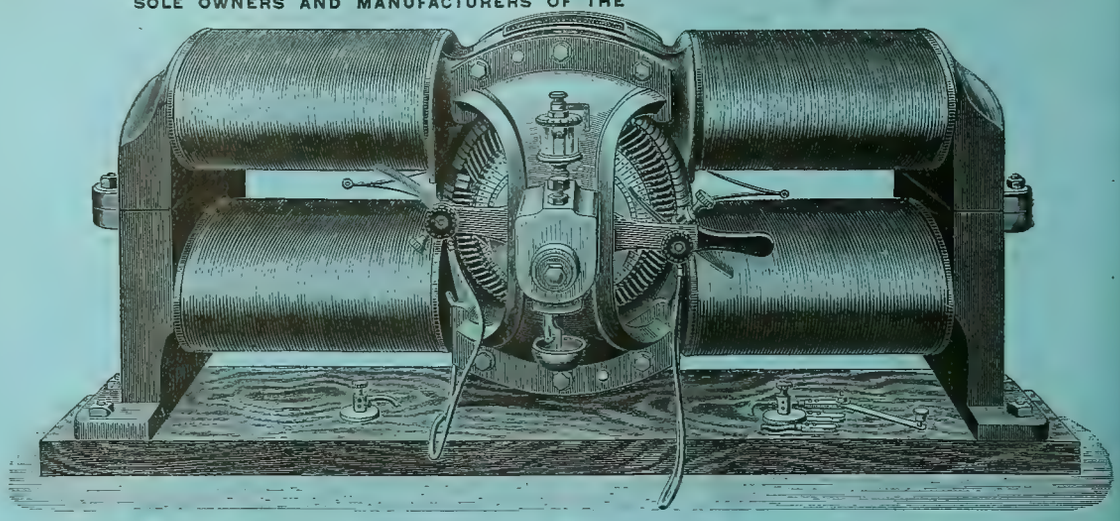

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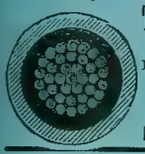

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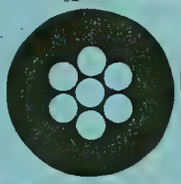

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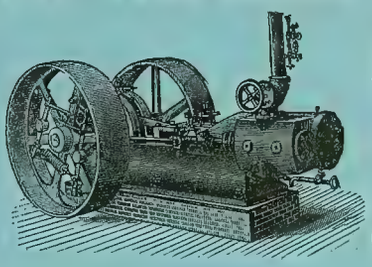

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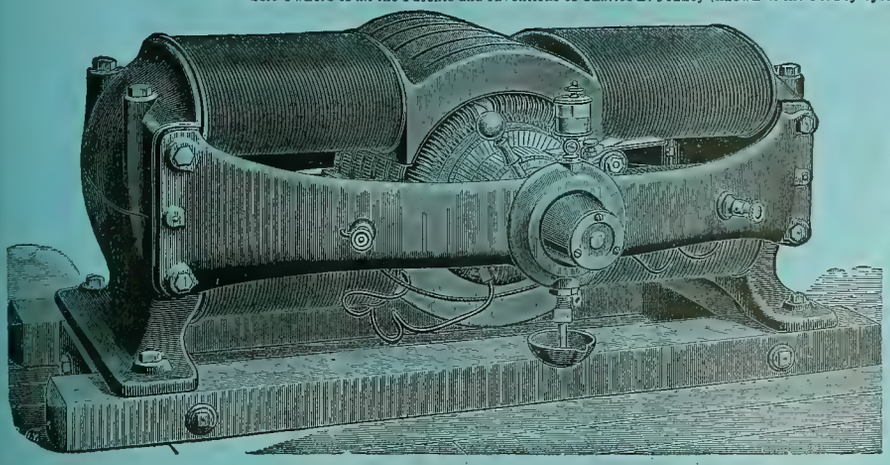

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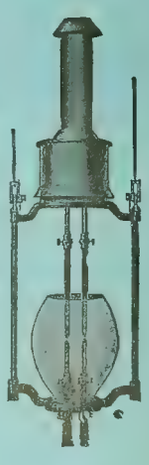

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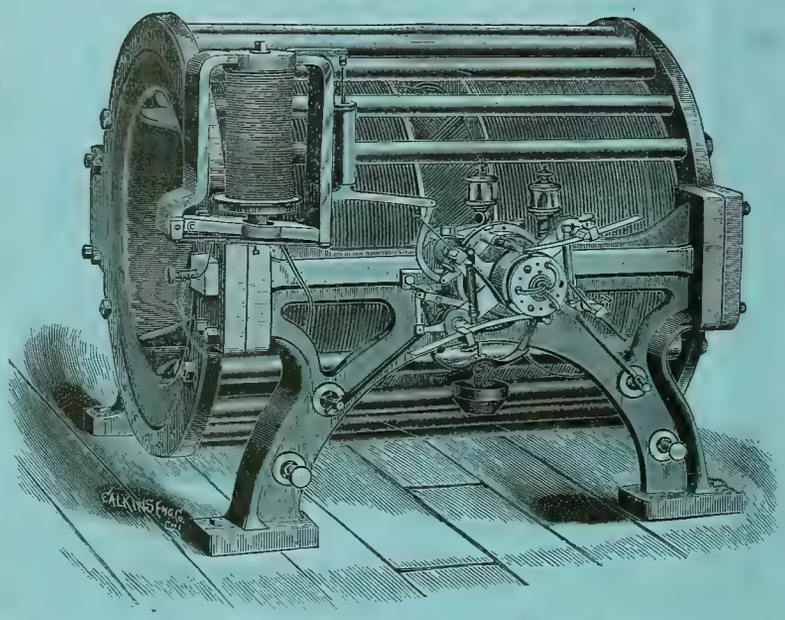

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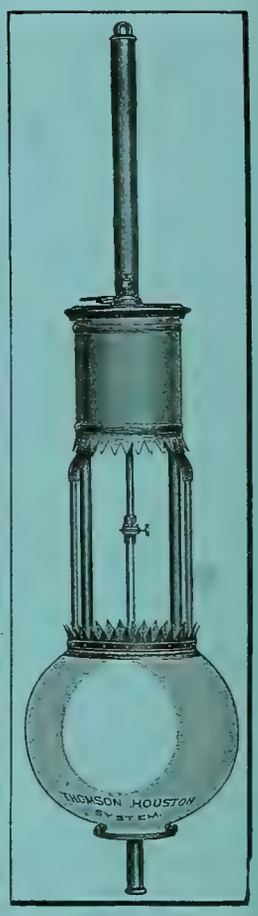

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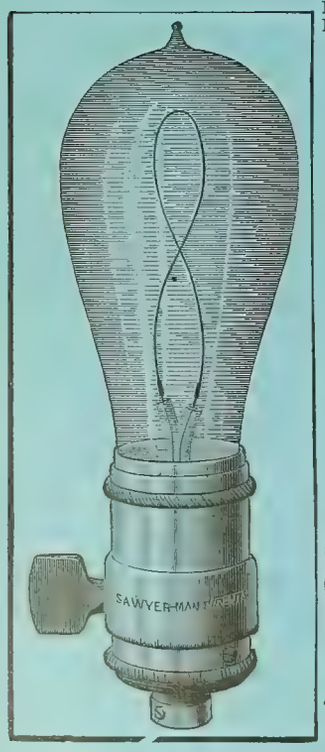
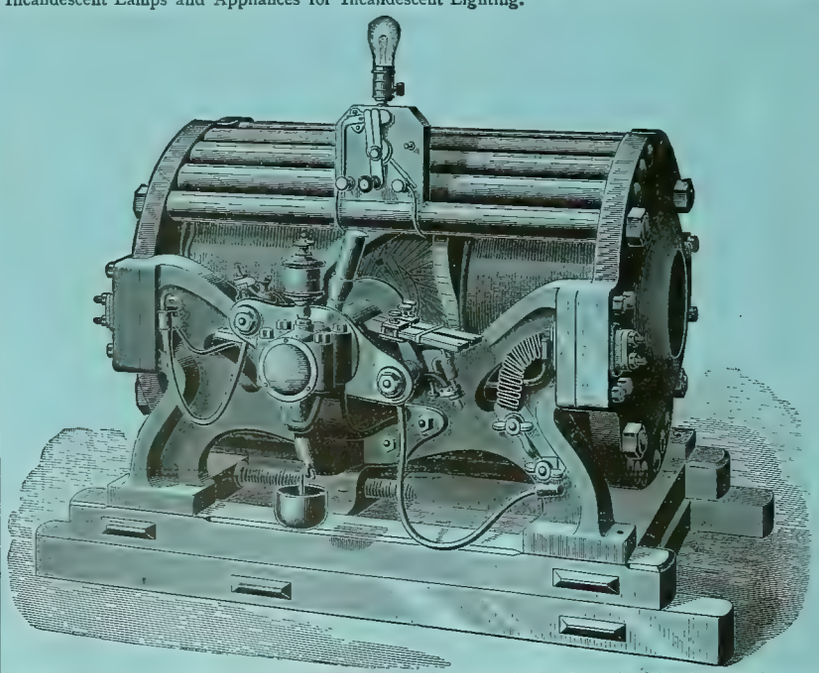
These dynamos are automatic in their regulation and will maintain a uniform ight, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteee life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

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OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

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IN

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12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

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The Electric Light put in my Theatre by your company is far beyond my expectations. Its system of lighting is perfect and is all that your representative claims for it.

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I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,

LAMBERT HAYS,
Proprietor People's Theatre.

Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO., 185 DEARBORN ST., CHICAGO.

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Incandescent Lighting Systems

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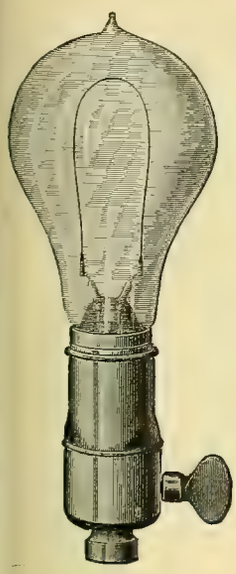

SUPERIOR TO ANY OTHER SYSTEM BECAUSE OF

More Light for a given amount of Power. Greater durability of Incandescent Lamps.
Better Mechanical Design and Workmanship. Absence of discoloration of Incandescent Lamp Globes.
The only Automatic Regulation in Dynamos. Completeness of details.
Precision and Reliability of Measuring Instruments;

AND BECAUSE OF

The only reliable system of comparatively low tension long distance incandescent lighting, using conductors of low cost. Mains costing approximately **$2.80 per lamp for a mile,** losing only five per cent. of current from dynamo to lamps;

AND ALSO BECAUSE OF

Incomparably the best **Alternating Current** or Secondary Generator System (high tension) extant, same covered by *fundamental patents,* and which are not used for advertising purposes, but for the protection of the users of our apparatus. In the use of this system, conductors (mains) at three per cent. loss cost approximately **70 CENTS PER LAMP FOR A MILE.**

BEWARE OF PARTIES POSING BEFORE THE PUBLIC WITH SO-CALLED ALTERNATING SYSTEMS

claiming rights under Gaulard & Gibbs' patent, No. 351,589, which has been found to be impractical and has been abandoned, and who are now infringing patents owned by the United States Electric Lighting Company, substituting same for their uncommercial and discarded system.

C. C. WARREN, WESTERN MANAGER,
216 La Salle Street, Chicago.

General Offices, Equitable Building, 120 Broadway, New York.

THE NATIONAL CARBON CO.

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ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

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Adapted to all Systems.

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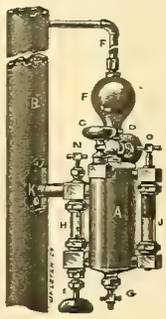

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Are pronounced the best by more than 20,000 users. They are especially adapted to

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Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

"I would not take five times the cost of my lubricator if I could not get another," is the statement often made by users.

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ENGINEERS AND CONTRACTORS OF

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Complete Steam Plants for Electric Light and Power.

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Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

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EDISON'S OPINION.

Geneva Non-Magnetic Watch Company:

Gentlemen:—During the past six months I have submitted the watches containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring to test in different fields of magnetism. I find them exempt from magnetic influence, however strong, and practically no retardation of the balance, nor change in rate occurs, even when in actual contact with Dynamos or powerful Electro-Magnets.

I have been carrying one of your watches, and going around Dynamos and other Electrical Appliances, where I have never been able to carry a watch without ruining it, and it has proved an excellent time-keeper. I consider Paillard's Balance a most wonderful and valuable invention, not only for workers around Dynamos, but wherever accuracy of time is required.

Very truly,

Orange, N. J., Dec. 7th, 1887. *T. A. EDISON.*

For Full Information about the Watches referred to in the above Testimonial, address:

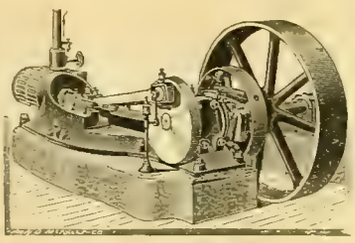
Geneva Non-Magnetic Watch Co.

(LIMITED.)

177 & 179 Broadway, New York.

Russell & Co.

MASSILLON, OHIO,
BUILDERS OF
AUTOMATIC ENGINES
BOILERS, ETC.
Complete Power Plants Furnished and Erected.
SEND FOR CATALOGUE.



Chicago Electric Club.

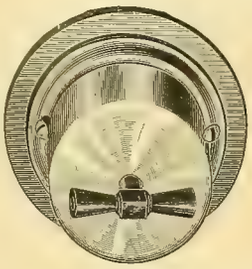
There will be a meeting of the CHICAGO ELECTRIC CLUB, Monday evening, January 16th, at 8 o'clock, at the rooms of the Club, 122-124 Clark Street.

Forest City Electric Works,

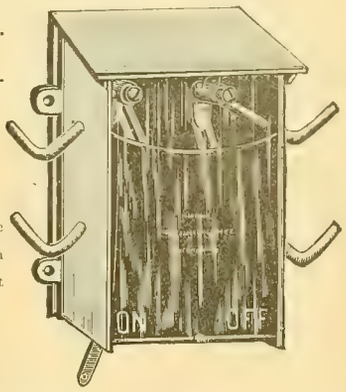
Manufacturers of CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.



Correspondence Solicited with Electric Light Companies.



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SELF CONTAINED AND SINGLE CRANK
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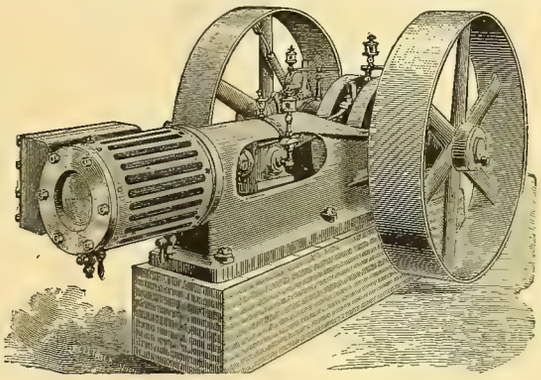
Specially Adapted for Electric Lighting.



WESTERN DEPARTMENT:
No. 10 S. Canal St.
CHICAGO.
H. S. WALKER, MANAGER.
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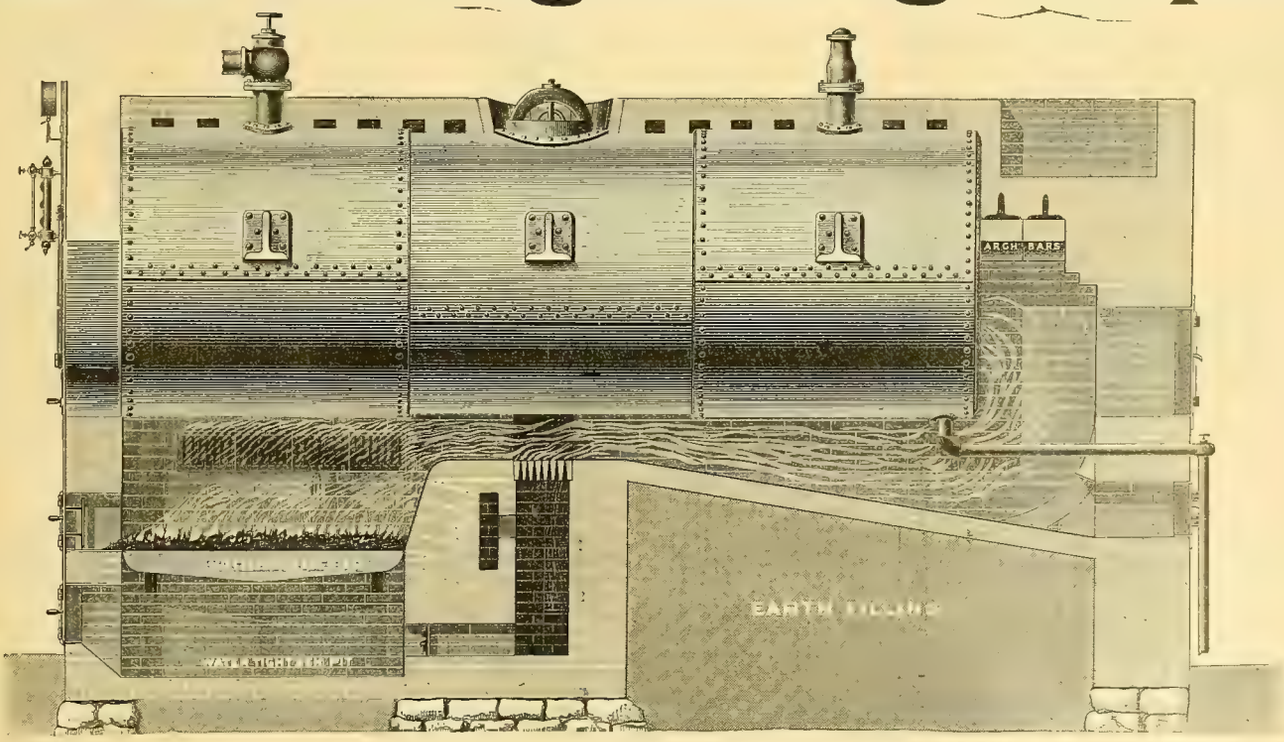
K. M. JARVIS, President. J. A. GRANT, Secretary. A. F. UPTON, Treasurer and General Manager.

The Jarvis Engineering Company

Engineers and Contractors.



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Burns Slack, Screenings, Coke, Breeze, etc. Correspondence solicited. Circulars, Catalogues, and general information furnished on application.

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COMPLETE OUTFITS OF STEAM MOTIVE POWER

For Electric Lighting Stations, Mills and Factories, including Boilers, Engines, Steam Pumps, Feed Water Heaters, Injectors Iron Stacks, Grate Bars, Boiler Furnaces, etc.

CHICAGO: 81 LAKE STREET.

BOSTON: No. 61 Oliver St. H. A. GLASIER, Mgr. Western Department. NEW YORK: No. 108 Liberty St.

We have a considerable quantity of **KERITE WIRE** size No. 13 B. & S. Gauge, 6-32″ insulation, which has been in use, but is practically as good as new.

We will send a sample of this wire and quote a very low price to any one who inquires.

WESTERN ELECTRIC COMPANY

CHICAGO—NEW YORK—ANTWERP—LONDON.

THE EDDY ELECTRIC MANUFACTURING CO.

MANUFACTURERS OF **Automatic Electric Motors** (MATHER PATENTS.)

In all sizes from ½ H. P. upwards. The efficiency of these Motors is over 92 per cent. They require no rheostat, are perfect in regulation, simple in construction, and thoroughly and substantially built. Also manufacturers of

THE MATHER DYNAMO ELECTRIC MACHINE,

FOR ELECTRO-PLATING, ELECTROTYPING, COPPER REFINING, ETC.

These Machines cannot reverse, use no water, do not spark, and are noiseless. Satisfaction Guaranteed.

THE EDDY ELECTRIC MANUFACTURING CO., HARTFORD, CONN.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

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18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

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OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

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AMERICAN ELECTRIC MANUFACTURING CO.,

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Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, DECEMBER 24, 1887. No. 26

The Bidwell Elevated Electric Railway.

The subject of rapid transit on the west side in Chicago has brought forward the advocates of elevated, surface and underground roads and various kinds of motive power. Upon the surface of busy thoroughfares rapid transit is quite out of the question and as rapid transit is the object sought recourse must be had to either elevated or underground roads. The former for various reasons seems to be preferred. The WESTERN ELECTRICIAN has already called attention to the superior merits of the electric motor for power in case it was determined to put up an elevated road, for then the noisy puffing and dirt, ashes and smoke of a steam locomotive would be replaced by the noiseless and clean motor, while the transmission of current either by overhead lines, by a third rail or by a conduit on a level with the rails would present no objections to those using the streets or the railroad, while that bane to most methods of transmission by street conduits—moisture—could be avoided.

In No. 4 of the WESTERN ELECTRICIAN, the Bidwell conduit system was described. Fig. 1, in connection, which shows the end elevation of a car upon the street surface, will serve to recall the essential features of the system. The conductors are in the shape of segments of a circle and are protected by being placed on the underside of the top of the conduit. A narrow slot is made in the top of the conduit through which an arm passes between the conductors. To this arm at the bottom is attached another arm carrying brass wheels which set into the conductors. The main arm is provided with a spiral spring which keeps the brass wheels at all times in close contact with the conductors. A modification of the system is seen in cut Fig. 2, where there are two arms instead of one, circuit being made from conductors through the brass wheels, the two arms and the motor on the car.

Mr. Bidwell has designed the application of the electric motor to an elevated road as shown by Figs. 2 and 3. He urges that the light superstructure shown by the latter is tasteful and will be an ornament rather than a detraction to a street upon which it is placed. Furthermore, he calculates that such an elevated road can be built at a cost not to exceed $100,000 per mile. Upon the road lightly built cars can be run at a rate of 30 miles an hour and yet the trains stop, if desired, at stations one-fourth of a mile apart. He would make the motor car fifty feet in length, reserving eight feet of the front end for the motor and leaving forty-two feet for passengers. This car with the motor will weigh eight tons which is one-half the weight of the smallest locomotives on the New York elevated railway. To the motor car he would attach two other cars each fifty feet long.

The leakage of current by this system of transmission, so perfect is the contact between brass wheels and conductors, is claimed to be nothing, so that, as Mr. Bidwell argues, he secures all the power produced by the dynamo which has an efficiency of 85 per cent. and consequently calculates that by his system a train of cars can be handled with a consumption of only one-third of the coal used by a locomotive.

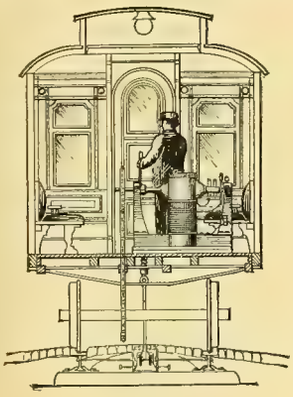


FIG. 1.

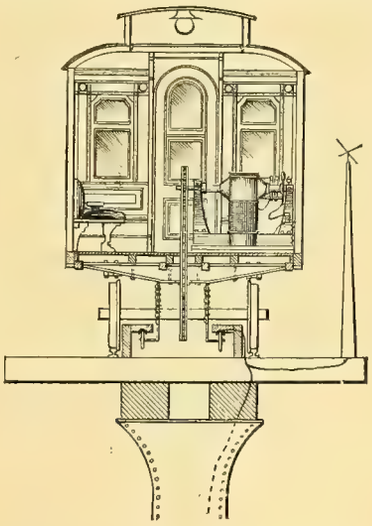


FIG. 2.

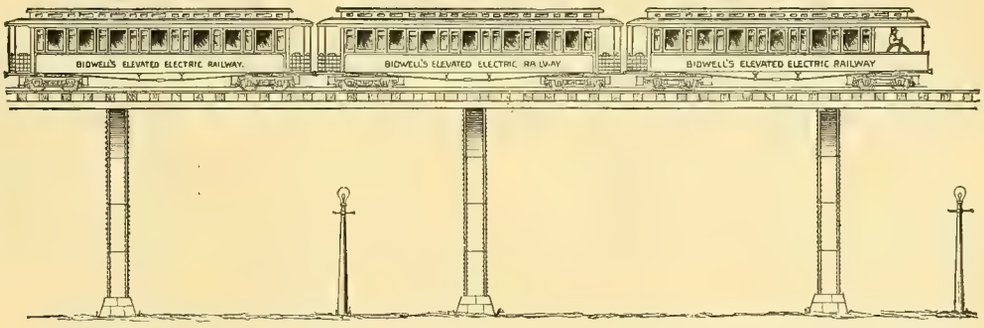


FIG. 3.

Chicago Electric Club.

First Vice-president Brown presided at the meeting of the Chicago Electric club Monday evening last.

The secretary reported that 19 applications for membership had been received since the last meeting, making the total number of applications, that had been filed with the secretary, 201, all of which had not, however, been acted upon by the board of managers.

Treasurer Terry filed, as usual, his regular report.

A discussion arose as to the advisability of changing the night of meeting from Monday to some other evening in the week, and it was unanimously voted to make no change.

Mr. Bliss read the paper on "Automatic temperature regulation," printed in full in this issue and accompanied by the discussion.

At the last meeting of the board of managers the following committees were appointed:

Executive committee,—C. A. Brown, chairman, F. S. Terry, C. D. Shain, H. Ward Leonard, W. A. Kreidler.

House committee,—F. B. Badt, chairman, F. W. Cushing, F. Stewart.

Billiard Table committee,—F. Stewart, F. S. Terry.

It was also decided to hold a banquet the first Saturday evening in January, 1888, and to place the arrangements in the hands of the entertainment committee.

Automatic Temperature Regulation.[1]

BY GEO. H. BLISS.

The subject of automatic temperature regulation is probably new to many members of the club. It is, however, a field of very great importance, and on account of the benefits to be derived in the shape of health, comfort, convenience and economy, deserves careful consideration. It should be kept in mind that in the season when artificial heat is required, automatic temperature regulation is available for use during the entire twenty-four hours of each day, and in this latitude for nearly eight months in the year. In this respect it has an element of advantage over artificial lighting, which is used on the average not more than three hours a day. The number of possible customers for the introduction of automatic temperature regulation is enormous, for the use of artificial heat is general.

So far, the efforts at the introduction of automatic temperature regulation have been largely educational, and the progress made has necessarily been slow, considering the vast possible territory to occupy. The advance made has, however, been considerable, and already it is used to a limited extent in public buildings, office buildings, hotels, club houses, churches, banks, manufacturing establishments, and in private residences. I will enumerate a few of the installations made, that a clear idea of the character of the business may be had. These references will apply to the Johnson system of heat regulation. In doing so it is not my wish to disparage or neglect other systems. For two years I was engaged in introducing the Johnson system, and hence am familiar with it. The limited time allowed me for the preparation of this paper has not permitted a careful research and analysis of the early attempts at automatic temperature regulation, nor such thorough examination of the systems which have recently come into the field as would have been desirable.

1 Read before the Chicago Electric Club, Dec. 19, 1887.

The following are a few of the Johnson installations: In New York—the American Bank Note Co.'s nine-story building throughout; Madison square Presbyterian church; Stock Exchange; Commercial National bank; Madison square theater; *Tribune* offices; Columbia College; Central Trust Co.'s new building; and many residences. In the Brooklyn Turkish baths. In Jersey City—P. Lorillard & Co.'s tobacco works. In Llewellyn Park—Thos. A. Edison's residence. In Boston—The city hall, Athenæum; Massachusetts hospital; Life Insurance Co.'s 100-room building. In Buffalo—The court house. In Cincinnati—The court house. In Detroit—The residences of Messrs. McMillan, Newberry, Helker, Smith and others; also the First National Bank. In St. Louis—The Bank of Commerce and M. A. Seed dry plate works. In Chicago—Eight public schools, Brother Jonathan building, 67 rooms; Union League club throughout; American Exchange, Commercial and National bank of Illinois; 50 such residences as those of S. M. Nickerson, H. H. Parker, Franklin MacVeagh, John B. Drake, C. B. Farwell, Jno. A. Roche and Robt. Lincoln. In Milwaukee — thirteen public schools, public library; Plankinton house, 125 rooms; Chapman's dry goods store; many offices and 125 residences. In St. Paul—Globe building, 133 rooms; three schools and several residences.

There are probably in excess of 500 of the most important Johnson installations throughout the United States, which is a mere commencement of the business.

The testimony elicited from those who have enjoyed automatic temperature regulation is clear and conclusive as to its value, and many of them could not be induced to give up its use on any consideration. Able physicians estimate that ten per cent of the sickness in this climate can be directly attributed to wide changes of temperature in connection with the use of artificial heat, resulting in colds, fevers, pneumonia, consumption and illness of various kinds. The ordinary person does not notice a change in temperature till it goes beyond the healthful comfortable point. Then heat is turned on or off as the case may be till an oppressive extreme of heat or cold is reached—windows are often opened causing dangerous draughts of air—some are too lazy to turn off heat and allow themselves to stay in an abnormally high temperature, out of which they may rush at any time into severe weather to be chilled and thereby subject themselves to unnecessary danger. All who have used steam heat are aware how extremely irksome and difficult it is to maintain a uniform temperature without automatic appliances.

On the other hand it is remarkable how quick a person accustomed to automatic temperature

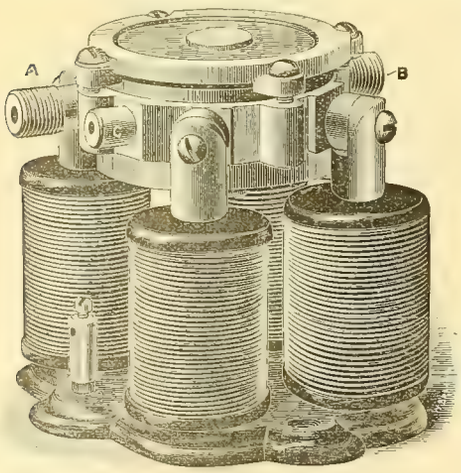


Fig. 2.

regulation will notice even the change of a degree or two from the established standard.

It is also singular that when persons accustomed to maintaining different degrees of temperature in the room they occupy, come together in apartments automatically controlled, they gradually gravitate in their preferences to a common standard, usually 70°, which becomes the most agreeable to each. The writer firmly believes that as Chicago has already acquired a somewhat famous newspaper reputation as a summer resort, it may, by the general use of automatic temperature regulation in cold weather, become a place equally desirable to spend the winter in health, comfort and happiness.

It may not be generally understood that automatic temperature regulation is more valuable in moderately cold weather than in severe cold weather in connection with most heating plants in this latitude. Heating plants in Chicago are generally put in with a guaranteed capacity sufficient for 20° below zero. In extremely cold

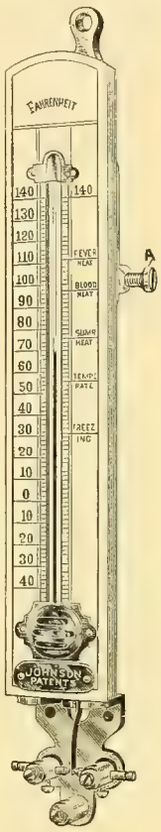


Fig. 1.

weather there is little to do except to crowd the fire to get heat enough. Even in this case automatic temperature regulation has some merit, for there will always be some rooms which come up to standard temperature quicker than others and from them the surplus is at once shut off and is available elsewhere. This results in a better distribution of heat, and in some cases results in materially increasing the capacity and efficiency of the heating plant. In mild days there is always a strong tendency to an excess of heat, and automatic temperature regulation is every instant ready to check this, thereby economizing fuel.

It must be clear to all that automatic temperature regulation does not create any heat and that its merits must be based upon the increased efficiency which it gives to the heating systems in use.

This is accomplished by the method already partially alluded to and as follows:

First. In a room where the temperature is automatically controlled it is the same as if a person stood with a thermometer in hand continually by the heat source to turn the supply on or off. Such a person's attention might be diverted, but the operator is instant in action.

Secondly. By holding the temperature at an even standard, a uniform fire can be maintained and perfect combustion of fuel secured with consequent economy.

Thirdly. By distributing heat only to points where needed, waste is avoided and a uniform condition is secured, often to great advantage even with a deficient heating plant.

The extent to which automatic temperature regulation will be applied in the near future can hardly be overestimated. Not only will installations be applied to large heating plants but cheap appliances will undoubtedly be made and attached to the common stoves found in the most modest homes.

An old adage says "There is nothing new under the sun." This certainly applies to the fact that there is little fresh in the idea of automatic temperature regulation.

In 1870 and 1872 Maj. A. Sternberg, an officer in the engineering corps of the United States army, who had been sent to Europe by our general government on special investigations and who has published scientific books of high character, took out some patents relating to automatic temperature regulation. These patents lay dormant until some months since when they fell into the hands of the Automatic Temperature Controlling company, of Milwaukee. A suit was brought under them against the Johnson Electric Service company, of Milwaukee.

In the latter's answer they cited a large number of English and American patents running back many years and antedating the Sternberg claim. This was so satisfactory that the suit was withdrawn and the parties in interest continued the development of their respective systems.

As is customary where there is an important prize to contend for, litigation of a varied character is progressing in regard to Automatic Temperature regulating devices, and, as in the electric light arena, it is found an expensive method of advertising the business. The Perfect Hatcher company, of Elmira, N. Y., operating under the patents of F. Rosebrook, have been active in the field of automatic temperature regulation, as applied to furnace and even steam heat since 1880, with some operative success.

The simplest form of antomatic temperature regulation is one which is applied to the furnace dampers alone. There have been various mechanical appliances attached to furnaces to open and close the dampers automatically, according to the varying condition of the fire in the furnace, depending for their action upon the expansion and contraction of metals or some confined fluid acted upon by the heat.

Such contrivances must be set every day, according to the judgment of the person who cares for the furnace, and he may be at fault as to the degree of heat needed, and sudden changes, especially, are not provided for by such an arrangement, except by readjustment. Moreover the proper place to regulate the temperature of a house is not at the furnace but in the rooms where the heat is to be used. To accomplish this result electricity is called into play.

There are various forms of electric automatic damper regulators, usually operated from some one central point where the temperature is to be controlled, and the place is chosen to represent, as nearly as may be, the average condition of the entire house. The power used directly to work the furnace dampers varies with the different systems, electricity in most cases being employed to start the mechanism into action.

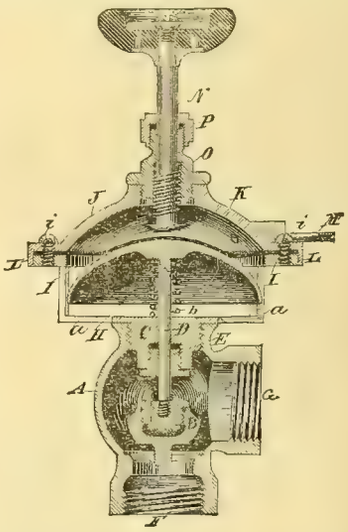


Fig. 3.

To properly control a furnace fire, whether hot air, hot water or steam heat is used, it is desirable to open the damper below the fire and close the one above at the same time to increase the heat, and vice versa to check it. There are several clockwork devices on the market in which the mechanism is tripped by electricity from the room where temperature is controlled. The objections to this are that a clock work must be wound up

occasionally, and special dampers of light weight are usually attached to the furnace. However when such installations are made with substantially constructed clockwork, very good results are obtained The Perfect Hatcher Co., of Elmira, New York, The Butz Thermo-Electric Regulator Co., of Minneapolis, Minn., and the Jacobs Electric Co., of Milwaukee, Wis., have apparatus of this character.

In another class of apparatus an electric current operates directly through a small motor. In other cases through a magnet to open and close the furnace dampers. I understand the Chas. E. Lee apparatus, of Rochester, N. Y., and the Automatic Temperature Regulating Co., of Chicago, belong to the motor class.

Of course, when the requisite movement has been accomplished, the circuit is broken so that the current is only in action while the dampers are in motion to open or close. In my opinion the best form of damper regulator using the electric current is manufactured by the Jacobs Electric Co., of Milwaukee. We have a sample of this apparatus here which will soon be submitted to the members of the club for examination.

An ordinary electro-magnet is used in this regulator, and four cells of open circuit battery are employed. As the armature is drawn to the magnet the circuit is broken, and as it is withdrawn by a spring the circuit is completed again.

The armature by a friction gear imparts a step by step movement to a wheel revolving therewith a crank from which by means of chains the dampers are worked. The operation of this apparatus is reliable, and there is with it a peculiar thermostat which will be explained later.

With specially light dampers four cells of open circuit battery will generally run this apparatus through a season, and as there is nothing to wind up and no compressed air to pump it requires little attention.

In the Johnson system of automatic heat regulation, compressed air is used to work the damper. The air is usually pumped into an iron tank to about ten pounds pressure to the square inch by a small hand pump, requiring attention once a day. The air is carried through small tubing to an electro-pneumatic valve and thence to a diaphram valve, by which means power is applied to the dampers. This system has a large working margin, for, by increasing the area of the diaphram valve, the ordinary dampers of the heaviest character are readily operated.

In all of the systems of automatic damper regulators mentioned, where the point of control is at a distance from the fire, an electric current comes over one of two circuits from a thermostat favorably located to act directly or indirectly upon the mechanism. Mercurial thermostats are not adapted for this purpose. They answer very well for fire alarms where there is an occasional closing of the circuit, but it is generally understood that electricity rapidly oxidizes mercury, and, as in temperature regulation, frequent closings of the circuit occur, mechanical thermostats are used.

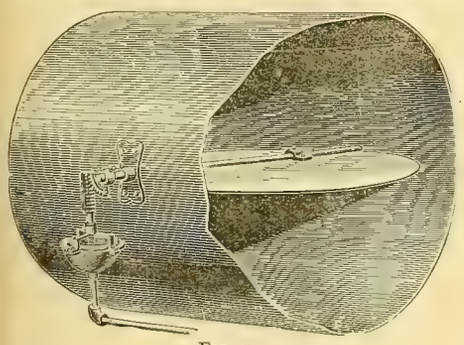


Fig. 5.

These are usually made, Fig. 1, by riveting together thin pieces of hard rubber and brass about six inches long and from one-half to one inch wide. The bar is fastened at one end to a back-board, upon the face of which is usually a common thermometer. The thermometer serves only as a guide by which to set the thermostat, and is a convenient indicator of temperature. As the materials in the thermostat bar expand and contract differently under changes of heat, the free end will move to the right or left as the temperature rises and falls.

This gives a convenient means for opening and closing the electric circuits. The current is brought to the fixed end of the thermostat bar down which it passes. By means of contact points on each side of the free end of the bar, the current passes to one of two circuits accordingly as there is a rise or fall in temperature of a degree from the established standard.

If the room becomes too warm the current passes over the circuit which will actuate the mechanism to check the fire; if too cool, then over the circuit which will stimulate the fire.

These thermostats are made so as to be easily adjusted to maintain any degree of temperature desired. They generally are provided with a small lever at the side, which can readily change the adjustment over a range of 15° to 20° of temperature. Most persons desire a night temperature in their homes considerably lower than during the day.

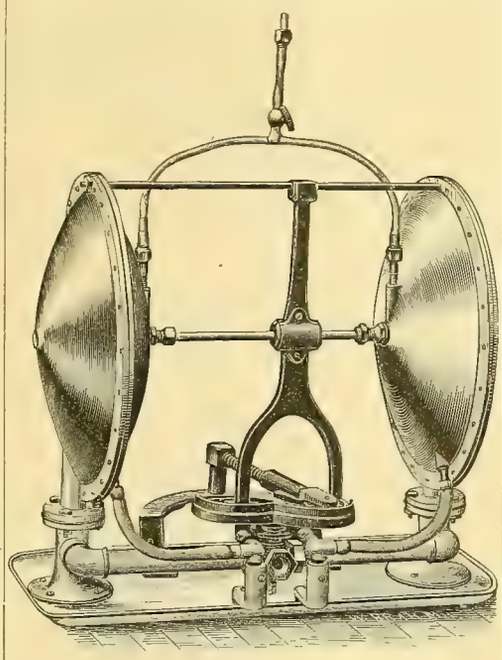


Fig. 4.

The tendency in all thermostats of this class is towards the higher temperature, and readjustment is usually required two or three times in a season.

The movement of a thermostat bar towards a contact point is sometimes very slow. If the points are at all oxidized, or if particles of dust have settled on them so as to give sharp contact instantly, the current may spark enough to impair an open circuit battery.

The Automatic Temperature Regulating company using the patents, have thought this trouble serious enough to inclose the points in a chamber excluding the dust, which is evidently only a partial remedy.

The Jacobs Electric company, using the patents of H. E. Jacobs, have a thermostat of peculiar construction. On each side of the thermostat is placed an electro-magnet, so that the instant the circuit closes current passes through the magnet and the bar is drawn over into firm contact at the points. There is no doubt in my mind as to the merit of this device where heavy currents are used.

Each of the systems of automatic damper regulation mentioned, should hold a uniform, steady fire in the furnace, and consequently secure perfect combustion resulting in economy of fuel. The writer has used the Johnson compressed air system at his house for two years. It has saved about three tons of coal, or 25 per cent. of the fuel each season. The attention required is to start three cells of Diamond Carbon battery once in the fall. One minute's work a day is used in pumping air. Coal is put into the furnace twice a day in moderate weather, and three times in severe weather. The dampers are never touched by hand. The ladies in the house prize the apparatus because it saves them from inconvenience, and the house is kept at a much more uniform temperature—usually within 5°—than is possible from personal attention.

Damper control is however only the beginning of temperature regulation. An attempt to regulate an entire house from one point only is necessarily incomplete. The temperature about a single thermostat may be uniform but if high cold winds are blowing, other portions of the house may vary widely from the desired standard. It is this fact which has already brought over 500 installations of the Johnson system into different parts of this country, which have been made at large expense where a large part of the rooms in the residences, buildings and factories have separate temperature regulation.

Vigorous attempts are being made to apply the clock and direct current systems to general temperature regulation, but I am not familiar enough with their working to sum up the results. My own experience has been that, especially with steam and where large hot-air dampers are to be moved, there must be available, ample and continuous power and that the Johnson combination of electricity for an actuating agency, and compressed air to do the work, fully meets the requirements of the situation. A small current of electricity from the thermostat readily operates the delicate mechanism of the electro-pneumatic valve, Fig. 2, to open and close the air ports.

With a moderate degree of air pressure, say 10 lbs., by increasing the size of the diaphragm in the steam or damper valves, Fig. 3, even 200 lbs. pressure can be applied.

In large installations the use of a hand air pump would be out of the question and hence an automatic water motor is used for the purpose, Fig. 4.

The use of compressed air is not an unmixed blessing. It is not an easy matter to pipe a large office building so that no air leaks will develop from settling walls and foundations, and accidental injuries be avoided. Both lead and iron tubing are used, each having special advantages for different services being where so much electric apparatus is multiple arced on a few open circuit cells, very slight escapes may make mischief. It has been found necessary to use wires having the best insulating—number 18 to number 14 wire is largely used.

The ignorance and carelessness of parties using the apparatus in its incipient stages has increased the daily difficulties of introduction. Increased experience has enabled much to be done to improve the apparatus and the business is now making enormous strides. The day is near at hand when no one will think a residence or office really comfortable without automatic temperature regulation. Before closing I desire to call the attention, especially of the electric light friends, to a point of great possible advantage to their interests. At the Union League club in this city they have two boilers to furnish steam for power and heat. Before their automatic temperature apparatus was started they were often short of steam. When the temperature apparatus was started in combination with a back pressure valve the exhaust from the pumps and engine furnished nearly the entire heat for the building. The Keiley back pressure valve used

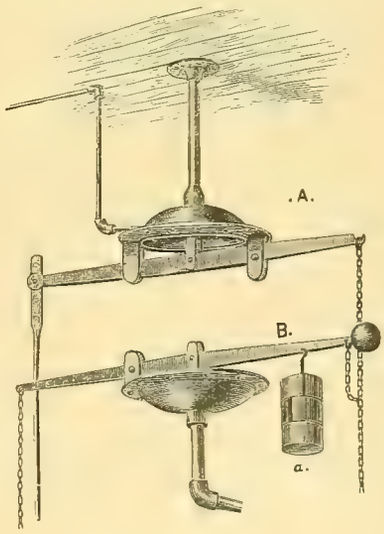


Fig. 6.

equalized the steam pressure in the heating system and the automatic temperature apparatus distributed the heat where needed. Not only did the club have a surplus of steam but as high as 60 tons of coal has been saved in one month as compared with previous records. To throw away the exhaust steam from the large electric light installations and from the pumps in large buildings, in my judgment is an enormous waste.

To give an idea of the regularity of temperature which can be maintained where the Johnson automatic apparatus is used I show you a few temperature cards from the High school at Hyde Park. They illustrate a common result which is now being regularly attained. It is simply impossible by the old method to keep any school room within ten degrees of a standard for any great length of time. There are about fifty school buildings in the United States equipped or being equipped with the Johnson system of temperature regulation.

In this connection I will show you a diagram of the method of equipping a building heated by the Ruttan system and controlled by the Johnson system.

In the American Bank Note Co's. building in New York the nine stories are heated by hot air driven into the flues by powerful fans. The temperature of this building is automatically controlled and it is the intention in summer to reverse the thermostat connection and control the current of cold air thrown into the building.

The Johnson system is now in operation on a railroad passenger coach, number 335, between St. Paul and Chicago. This car is heated by steam from the engine and thereby all danger from fire from stoves is avoided. The ordinary diaphragm valves are used and compressed air is taken from the brake system. The car has made 10,000 miles and the temperature is maintained within 3° of standard. On account of the jar a special thermostat is used on the principle of the steam gauge which obviates any extra closings of the circuit at the contact points. It is entirely possible with their system of heat regulation to provide an indicator system showing to the engineer the condition of each room. This has been done in the American Bank Note Co's. building and to partial extent elsewhere, notably at the M. A. Seed Dry Plate works in St. Louis where some of the rooms are seldom entered.

Mr. Bliss explained the Johnson system in detail by reference to the apparatus. The operation of the thermostat is made clear by the letter press description and the illustration, Fig. 1. The electro-pneumatic valve shown in Fig. 2, is so arranged that a current from either side of the thermostat energizes two of the magnets which in turn attract an armature that trips a light air valve in a pipe leading from a reservoir containing compressed air which is utilized to operate the mechanism for governing the supply of heat. The pump shown in Fig. 4, is attached to the water mains of a building and automatically keeps up the supply of compressed air. Where steam is used for heating the diaphragm valve shown in sectional view in Fig. 3, is used, *A* is the valve body; *B* the valve disk; *C* the packing box through which the steam passes; *H* is a saucer shaped piece, fastened to the upper end of the stem *D*. The valve is held open by the steel spring *b*, which presses upwards to the saucer *H*. Above this saucer *H* is the umbrella-shaped piece *J*, held by the standards *a*, *a*. Upon the under side of the piece *J*, and fastened firmly to its edges to produce an air-tight joint, is the flexible diaphragm *K*, made of cloth and rubber. There is an opening through the pipe *M* into the chamber formed between the metal piece *J* and the diaphragm *K*. If air, under pressure is admitted through the opening *M*, that the valve will be pushed downward to its seat. When the air is allowed to escape from above *K* the spring *b* will open the valve *B* to its full extent.

Fig. 5 shows a butterfly damper regulating the supply of heat from a furnace to a room and Fig. 6 shows a draft regulator to a furnace.

Another form of themostat was shown with magnets on either side of the free end of the thermostat bar, so arranged as to force a more perfect contact of the lower end of the bar with the points on each side.

Still another form was shown constructed on the principle of the steam gauge, that is a coiled spring tube partially filled with alcohol, and connected with a pointer which moved over a considerable space, the pointer making connection at either end of its movement in a similar manner to the free end of the thermostat bar.

The record at the High school in Hyde Park for one week, in one room—records being made at the end of every half hour—showed that the highest temperature was 73 degrees and the lowest 70 degrees; in another room the highest 72 degrees, the lowest 70 degrees. The aim was to keep the temperature at all times at 70 degrees, and the variations from that point were very rare.

The Ruttan system, explained by diagram, showed the methods of connection of the apparatus with all dampers in the pipes leading from the furnace.

At the close of the reading of the paper a vote of thanks, on motion of Secretary Kreidler, was tendered Mr. Bliss.

Chairman Brown inquired if in the Jacobs thermostat one side was of brass, and if it did not have a special armature.

Mr. Bliss replied in answer to the first query that the Jacobs and Johnson thermostats were exactly alike in that respect, and to the second that a short iron bar was attached to the regular armature. Thermostats, said he, in most cases are made of hard rubber and brass, but in some cases, especially where they were to be used in high temperatures, steel and brass were employed. Any two substances which have a difference of expansion and contraction could be used in a thermostat.

Mr. Sperry inquired what was the reason of the necessity for readjustment of the thermostat once or twice during the season, and if it was due to the deterioration of the rubber.

Mr. Bliss replied that he always supposed that after expansion under a somewhat higher temperature than prevailed when the thermostat was put together, the particles of rubber expanded and never receded to their original condition.

Mr. Leonard said he presumed that rubber and brass made a very sensitive combination.

Mr. Sperry had often wondered why rubber and brass, were generally used. He had seen a combination of steel and copper and steel and brass, but he thought a combination of rubber and German silver would make a far more sensitive thermostat.

Mr. Bliss humorously replied that he had always found that it required a good deal of brass to sell the apparatus, and consequently he had never investigated the different combinations mentioned by Mr. Sperry. But he had had a little experience with two kinds of metal in the Hill thermostat. When the old firm of Bliss & Tillotson was in existence they had fitted the old Sherman house in Chicago with these thermostats, but the delicacy of the thermostats was such that the instruments sounded any number of false alarms and caused any amount of trouble; "if the Chicago fire" said he, "was of benefit to anybody it was to me in burning up the Sherman house and its thermostats."

Mr. Leonard had noticed that the combination of brass and steel in the Edison meters had a very marked constancy.

Mr. Warner inquired if Mr. Bliss had arrived at any definite idea as to the best location of a thermostat in a room.

Mr. Bliss said that it did not make any difference where the thermostat was placed as far as maintaining the temperature constant was concerned but it was well known that the temperature in the lower part of a room was always lower than in the upper part. He preferred to place a thermostat on an inside wall and at about the height that a thermometer would be placed.

The First Electric Transfer Table.[1]

The first application of electricity as the motive power for transfer tables has been made at the Aurora shops of the Chicago, Burlington & Quincy Railroad company. The pit in which this table is being placed is 325 feet long and 66 feet wide, and lies between the paint shop and the erecting shop, facing thirteen doors on each side and an equal number of tracks. The table is 65 feet 9 inches long, and about 15 feet wide, carrying one set of rails, and weighing about 15 tons. At one side the table has been built out to receive the motor and mechanism, and it is this portion that is shown in the accompanying cuts. Fig. 1 shows the motor and mechanism, as viewed from above, with the platform removed. Fig. 2 shows a longitudinal section, and Fig. 3 a tranverse section of same. Fig. 4 shows, in enlarged scale, the motor and its gearing to the actuating shaft. The operation of the table and its mechanism may be understood by the following description of the travel of the power from the motor to the driving wheels, like letters indicating like parts in the several engravings.

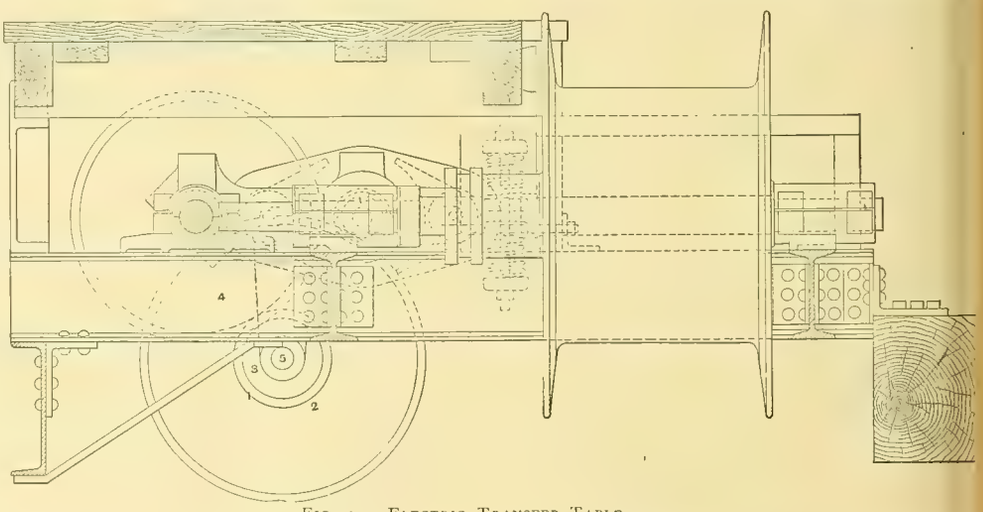


Fig. 4. — Electric Transfer Table.

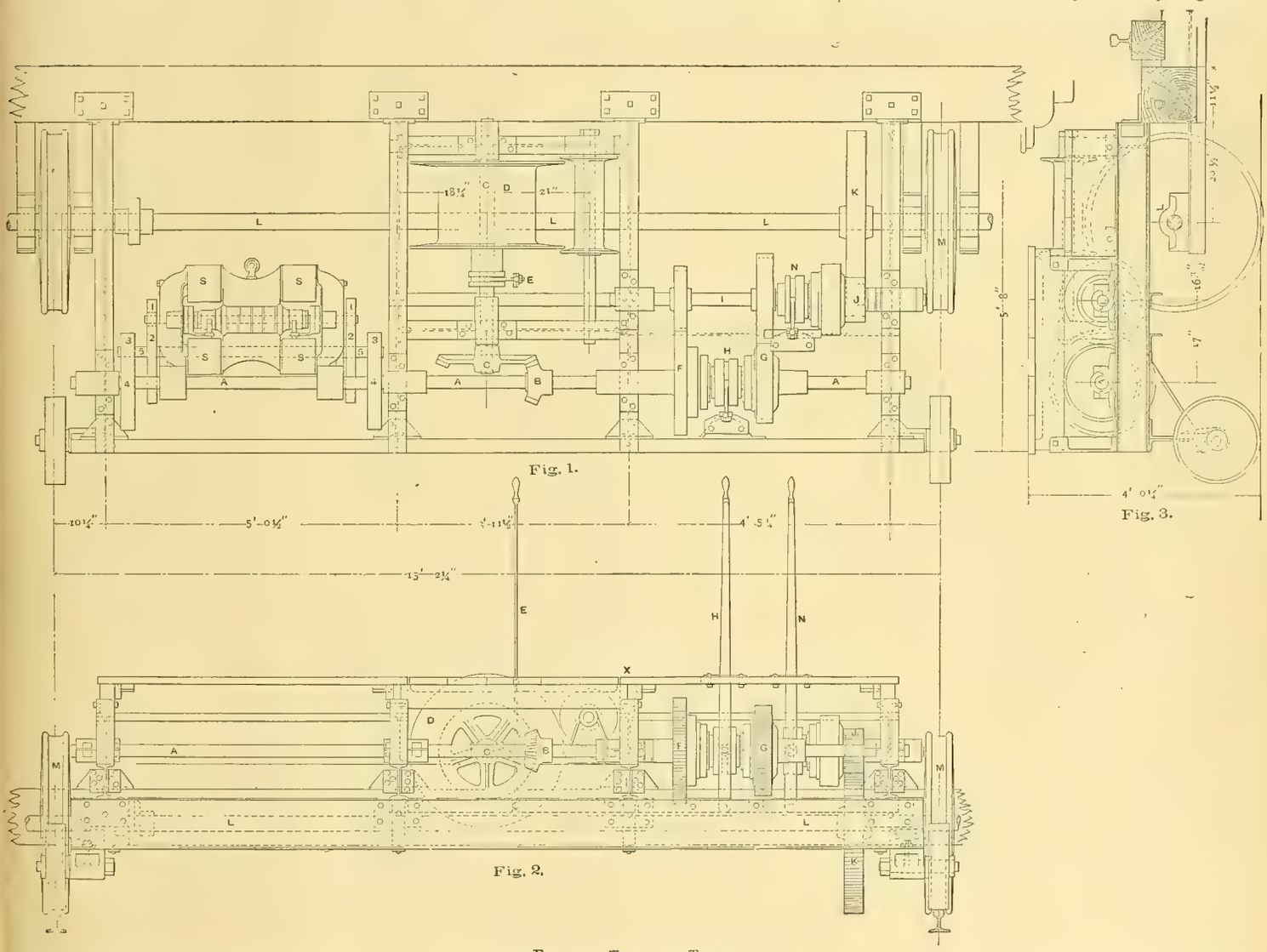
The motor *S*, *S*, *S*, *S*, is geared to the actuating shaft *A*, *A*, as shown in Fig. 1, and, in clearer manner, in Fig. 4. The details of this gearing are indicated by numerals. 1 is the small gear borne by the spindle of the motor; this engages with the large gear 2, carried on the intermediate shaft 5; this shaft bears another and smaller gear, 3, which engages with the large gear, 4, carried by the actuating shaft *A*. Following this shaft *A* to the right the bevel gear *B* is reached, which carries motion to the shaft *C*. This shaft bears a drum D, upon which is wound the rope with which the car is drawn from the shop onto the table. This drum is placed in or out of motion by the clutch *E*. This device is geared to give a motion to the car of about 132 feet per minute. Going back to the shaft *A*, and following it further to the right, we see the gears *F* and *G*. Either of these is thrown into gear at will by the clutch *H*; they are geared up, the first to give a speed to the table of 100 feet per minute and the second to give a speed of 200 feet per minute. The motion is now transferred to the shaft *I*, which gears at *J* with the main driving gear *K*, carried on the main driving shaft *L*, and thus the driving wheels *M* are caused to revolve, and the table moves. The transfer of

[1] *The Railway Master Mechanic*, December, 1887.

power from shaft *I* to the main shaft *L*, through the gear wheels *J* and *K*, is effected by operating the clutch *N*.

The manipulation of the table is very simple. An electric switch is placed at about the point marked *X*, Fig. 2, within easy reach, it will be seen, of the clutch levers. A single motion of the switch starts the motor; with the clutch lever *H* the desired speed is geared in, with the clutch lever *N* the drivers are thrown into gear, and the table moves to the desired door of the discharging shop. The car is attached to the hauling rope, which is caused to be wound up on the drum *D*, by moving the clutch lever *E*. When the car is aboard the table, the latter is moved to the desired door of the receiving shop and the car is moved off by the same drum *D*. The operator of the table has all the levers and the switch within easy reach. The table moves readily in either direction, as the motor is reversed at will.

The electric power reaches the table from an overhead wire, carrying a trolley from which depends a wire leading to the motor. The dynamo is located in the main engine room of the shops, distant 750 feet from the table. It is operated by power belted down from the main shaft. The dynamo is of the Edison number 7 pattern, producing 15 horse power. The motor is of 7½ horse power. The dynamo is of the greater power for the reason that it is proposed to utilize it also for an electric lighting system, whenever it is deemed advisable to light the shops. The tractive resistance of the table, light, is about 250 pounds, and when loaded with a Pullman car about 1,500 pounds—both at slow speeds. The motor used is that made by the Sprague Motor company and is the first electric motor ever applied to such a use. The entire gearing for the table was supplied by the Yale & Towne Manufacturing company, with headquarters at Stamford, Conn.



Electric Transfer Table.

The Keely Motor.

The first annual meeting of the stockholders of the Keely Motor company since 1883 was held in Philadelphia on the fourteenth, and was attended by about seventy-five stockholders, representing nearly seventy thousand shares. The board of directors in their report arrive at the following conclusions: 1. The directors are more than ever satisfied that the enterprise is absolutely based upon the application of a a new motive power. 2. That Mr. Keely has underestimated in many particulars the time necessary to the completion of his work. 3. That, notwithstanding the doubts expressed in some quarters, the board still has high hopes, a steady, and in fact, wonderful progress having been made in Mr. Keely's work. 4. That the chief difficulties have been removed, and we are now in sight of the results.

Mr. Keely made a long report, in which he reviews his work since 1882, when he was engaged in the construction of a generator for the purpose of securing a vaporic or etheric force from water and air, but which, when completed, was found to be impracticable owing to impossibility of securing graduation. After a succession of experiments he produced in March, 1885, what he termed a liberator, which could be operated in conjunction with the generator, and was a vast stride in advance of anything accomplished hitherto. Meanwhile phenomena had been unfolded to him, opening a new field of experiment, as the result of which he became possessed of a new and important discovery. Hereafter he shall not, he says, require either the generator or the liberator, and his operations will be conducted without either the vaporic or etheric forces. What name to give his new form of force he does not know, but the basis of it all, he says, is vibratory sympathy. It may be divided, too, into negative and sympathetic attraction, these two forms of force being the antitheses of each other. He would fix no time for the completion of his work, but his ultimate success, he still holds, will be greater than even his most sanguine advocates have predicted. Mr. Keely admits that it would have been better, perhaps, at the time he changed base to have let it be known than to have encouraged a belief that he was still engaged on his etheric and vaporic forces.

Among the work yet to be done is the construction of a sympathetic machine of a very delicate character. While this will be a perfect vibratory structure itself, its function is to complete the work of graduation or governing of the force.

A Government Telegraph.

On the 13th Senator Cullom introduced in the United States senate a bill providing for the establishment and operation of a U.S. postal telegraph of ten trunk lines, embracing all the cities of the states and territories. The bill provides that the lines shall be constructed by the army engineer corps, under the direction of the secretary of war, on iron poles, with capacity for twelve wires, and shall, when completed, be transferred to the control of the postmaster general. The secretary of war shall, if he deem it expedient, take possession of lines now used for military purposes as a portion of this federal telegraph system. The rates to be charged are 10 cents for twenty words under five hundred miles and 5 cents additional for each additional ten words, and for distances greater than five hundred miles an additional rate of 5 cents for each 250 miles. Press night rates are to be 35 cents per 100 words and day rates 75 cents per 100 words. The office of director-general of telegraphs is created, the appointment to be made as is that of an assistant postmaster general, with like salary.

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THOSE valuable concessions from China to a syndicate of American capitalists reported to have been withdrawn are declared by Count Mitkiewicz to be as "firm as the rock of Gibralter" in the possession of the syndicate to whom they were originally granted. The count declares that Mr. Barker, the Philadelphia capitalist who is at the head of the syndicate, will go to China next mouth to open the bank.

BARE copper, wire is still on the rise. Last Monday 24 cents for ordinary sizes was quoted as the ruling market price, but what it would be a week from that day no seller would venture to predict. An offer of 21 cents for a large order was made by one Chicago house a week ago today, and was declined. Monday the recipient of the offer had changed his mind, but the would-be sellers had done the same thing, and the order at 21 cents was refused. Copper wire dealers are firm in the belief that wire will sell at a still higher price.

THE telephone world is all agog over a rumor that the United States supreme court has passed upon the telephone suits before it and that the majority of the justices have decided against the Bell Telephone company, but that the decision has not yet been made public for the reason that the minority desire time to prepare an opinion. Coupled with this announcement is a reference to fluctuations in telephone stocks on the Boston board last week and which is used to bolster the rumor, and give it a healthful color. Secrets of the United States supreme court, however, do not often leak out except in imagination and while the rumor is plausible it is not sufficiently authenticated to cause any serious uneasiness among telephone stockholders at the present moment.

AT Rochester, N. Y., on the 16th inst., the executive committee of the People's telephone association met, and considered flat rates proposed to it by the Bell telephone company. These rates were for single lines: Business places $72, professional offices $60, private residences $48. For combination lines the rates named were: For business places $60, for professional offices $48, for residences $36. In order to learn what the committee would consider a just rate, a vote was taken, thirteen members voting. There was considerable variation, but the average rates were: On single lines, for business places $55, for professional offices $44, for residences $36. The rates of the Bell company were based upon a proposition to place the wires underground gradually, to be completed within three years. On motion, the Bell company's terms were rejected, and a resolution to the effect that the committee recommend the association to offer the Bell company the average rates agreed upon was unanimously adopted.

THE paper on the revision of the patent law, presented by Arthur Steuart, of Baltimore, Md., of general counsel to the National Electric Light association, before the American Institute of Electrical Engineers December 20th, and reproduced in part in this issue, is a comprehensive and logical exposition of needed reforms in both patent law and patent office methods. The scope of the paper is very broad and yet the whole subject is treated in a masterly manner with fullness and yet without prolixity. As Mr. Steuart says, he does not attempt to formulate specific additions to the statutes for he believes that that work can only be done effectually by a commission of expert lawyers such as is contemplated in the bill proposed to be submitted to congress.

There seems to be no question that the need for reforms is urgent and no better way could be devised of securing those reforms than the appointment of a commission composed of men thoroughly versed in present methods and practice and who know so well the faults and deficiencies of both.

IN the equity term at Rochester, N. Y., on the 13th, the case of the People against the Bell Telephone company, of Buffalo, was placed on trial. This is the somewhat celebrated action to compel the defendant corporation to remove its poles and wires from the streets of Rochester. The action was begun several months ago as one of the steps in the contest between the Buffalo company and its Rochester patrons. A short time ago there seemed to be good reason to believe that the differences would be speedily adjusted, and one of the clauses in the proposed agreement provided for the cessation of all litigation. After the negotiations had been going on for some time they suddenly ceased, and since then the war has been waged as bitterly as ever. After the examination of a few witnesses, the defendant's counsel made a motion that the Western Union Telegraph company, the electric light companies and the city of Rochester be made parties defendant, on the ground that they also use the poles which the action seeks to remove from the principal streets of the city. Justice Rumsey granted the motion, and the case temporarily came to a stop.

IN another column will be found the discussion on Mr Stanley's paper on the retardation of current with alternating current dynamos, published in the last number.

The discussion, as will be seen, was mainly on certain technical points, as the synchronism required between two or more alternate current dynamos, whose mains are connected in multiple arc. On this point Mr. Stanley mentioned two interesting facts: That the pole pieces of dynamos so connected must have precisely the same amount of iron, and also that the mutual interaction between two dynamos so connected tended to produce synchronism. It was also shown that with the alternating system and transformers, the regulation is such that a variation in the number of lamps in circuit does not affect the constancy of the illumination which each lamp produces.

Mr. Stanley claims that the alternating system is the most economical, the economy being due, in part at least, to the elimination of the resistance of the commutator required in the constant current system. Whether this economy is real or only apparent remains to be seen, and as the system in this country is scarcely more than six months old, it is too soon to determine so important a point with accuracy. Various American companies are now giving it a trial, and if the results should prove satisfactory, it may eventually revolutionize our whole system of electric lighting.

NEARLY as ingenious as the promised phonograph of Edison are some of the applications devised for it. Witness the following from the Cincinnati *Commercial Gazette:* "In all that has been written about the uses to which the Edison phonograph will be applied, nothing has been said of the facilities it will give persons who can neither read nor write for correspondence. Indeed, there is no doubt that there will be an immense demand on the wonderful powers of the instrument from this class. The instruments into which books have been read will also repeat them to the blind, and those thus afflicted can have the choicest treasures of the libraries of the world at their service day or night. The invalid, too, whose friends are away or busy or asleep, can have have his faithful reader always at command. The thought that suggested the paragraph is this: What a valuable thing a phonograph would be on a rapidly moving train during a long journey. It is hard on the eyes of many to read in traveling, or at night the light is insufficient, or the car is darkened for sleeping. The restless passenger may have his faithful phonograph in his berth, and with the earphone adjusted can listen to the sweet voice—at will, without disturbing anybody. Then, too, all know the difficulty of writing on a train. This will now be overcome. Not only for business correspondence may it be used, but an author's best thoughts often come to him amid the waits or among the inspiring scenes of a long journey. These may be faithfully recorded."

THE paper on the conductivity of glass, by Nelson K. Cherrill is of practical importance, not only with reference to the globes for incandescent lamps, to which the article especially refers, but for all electric instruments in which glass is used, more especially those used in connection with electricity of high tension, as furnished by the dynamo or the Holtz and Töpler machines.

The experiments show that resistance varies rapidly with variation of temperature above or below 60° C., lead glass being especially subject to this variation, a species of electrolysis taking place in such glass by which lead is deposited around the platinum terminals in the globes of incandescent lamps. This electrolytic result in a solid substance is an additional proof that electricity is a species of molecular action. As soft flint glass always contains lead, its use where high resistance is required, as in the globes mentioned and elsewhere, is objectionable.

In the well known experiments with the Crookes' high vacuum tubes, the results attributed by Crookes to "radiant matter" bombarding the glass and heating it are more properly attributable to the conductivity of the glass, as shown in Atkinson's "Elements of Static Electricity," chapter X.

As the glass used for battery jars is of the kind referred to, there must be a certain percentage of electric loss, which, in a large battery joined in series, may be quite appreciable, though probably not noticeable in small batteries. For Leyden batteries and jars such glass is of course entirely worthless.

THERE is much that is interesting in the application of the electric motor to the transfer table at the Aurora shops of the Chicago, Burlington & Quincy railroad company, clearly described on other pages and illustrated by cuts showing the details.

It is said this is the first electric transfer table; as such it will claim much attention. But of more interest is the peculiar adaptibility of the electric motor to the place. The conditions, as recounted in the description, were a transfer table 750 feet distant from the main engine room of the works; power necessary to draw cars upon the table; to turn the table a part or whole of a revolution and return the car upon another track to the shops. Steam power would involve either an independent installation of an engine and possibly a boiler, or a long line of shafting, countershafting and gearing, or some other method of transmission involving considerable expense both for first cost and maintenance. Instead of any of these methods, recourse was had to the electric motor, the transmission of the current being at a short distance from the source of supply, a power that can be readily applied at any time, that is satisfactory under all circumstances, that requires no specially skilled man to handle it and all at a moderate cost. Moreover the same dynamo that furnishes power for the transfer table can be utilized to furnish lights to the shops. These are but a few features of an installation that presented no great problems to the electrician, but which very easily overcame what would have been mechanical difficulties to any other form of power.

Revision of the Patent Law.[1]

BY ARTHUR STUART.

PART I.

I come before you this evening at the invitation of your secretary, for the purpose of telling you of the effort that is being made by the National Electric Light association to secure some reforms in the patent laws of this country, and of attempting to get you to join hands with us in carrying these reforms into effect. I particularly desire that the suggestions I shall make may be fully discussed by those present, for I hope to gain many valuable suggestions from you. For the purpose, therefore, of presenting what I have to say in the shortest possible time, so as to leave as much as possible for other gentlemen, I have condensed my suggestions and shall state them with very little argument; first, for lack of time, and, secondly, because I think most of the reforms suggested are so apparent that they will call forth little opposition. But, before proceeding to discuss the details of the law that require changes and additions, I cannot refrain from making a few remarks upon the patent system in general and its influence upon the industrial development of our country.

Who can measure the benefits that this land has derived from the inventions that have been produced by its citizens? The roll of honor is too long to be repeated. The cotton gin, the printing press, the reaper, the application of steam to all the uses of civilization, and, latest but not least, the modern application of electricity in its multitudinous forms; but while these brilliant achievements occupy our attention, we must not overlook the thousands upon thousands of inventions relating to matters of detail in every industry, that have cheapened the product by saving time, material, power or labor. The fact is apparent that our advancement as a manufacturing nation has been due to the introduction of new methods of work, which have enabled us to produce staples at such a price as to compete with other nations in the markets of the world, or in the development of new devices which have supplanted old ones or created a market for themselves. This being true, we must look for a cause for this development. What has induced the people of this country to create so many new things, to labor so long and arduously to lessen the cost of production of some articles, or to supply new ones to take their place, which are better or cheaper?

I think we may state it as a proposition which will not meet with denial, that the prevailing motive of the American people is a motive of pecuniary gain, a desire to amass wealth, to attain power by means of money; and whatever avenue offers them this reward will be the one into which they will press with a vigor and determination that knows no such thing as failure.

When the framers of our constitution inserted into it the clause which provides that "congress shall have power to promote the progress of science and the useful arts by securing * * * for limited times to * * * inventors the exclusive right to their * * * discoveries," they laid a foundation stone upon which an edifice has been constructed that has far surpassed anything they had conceived. Upon this provision of the constitution is our patent law based; from it, it takes its spirit and with the view of adhering more closely to this spirit have the amendments to the patent law been suggested to which I shall ask your attention this evening.

The patent laws of the United States, passed in pursuance of this provision of the constitution, open up before every citizen of this country, as well as before those of many others, opportunities of obtaining wealth and power which are not presented by any other set of circumstances under the sun. In a single moment of time by a quick operation of the mind, the poor mechanic may be put into possession of an idea that by its own development may place him among the princes of the land.

This is the possibility that presents itself to every man, rich or poor, high or low, who comes to understand the meaning of our patent system and its results.

[1] Read before the American Institute of Electrical Engineers, New York, Dec. 20, 1887.

What force can be compared with this to produce in the minds of men thought, deep, concentrated and continuous, for the production of inventions, a thirst for knowledge and a frugality of life that will supply a surplus of funds for the acquisition of knowledge and the development of inventions, and an ambition for their children that they shall have greater advantages of education upon which to work than their parents? And who can estimate the value to a state of such influence upon its citizens. This training, foreign manufacturers testify, produces in American operatives a power of comprehending their work and a rapidity and dexterity of workmanship that makes it impossible for the former, with labor at one-half the cost and their factories fitted with the latest American machines, to produce the same goods as cheaply as they can be produced in this country.

It therefore goes without saying that with such an inestimable good to the nation, both in improving its industries and its people, to be attained by stimulating inventors to their highest effort, the only true course for the law makers to pursue in framing legislation relative to this subject, is to endeavor to make the process of obtaining a patent upon an invention as quick, easy and inexpensive as possible, and after it is granted, to throw around it, in the hands of its owner, every form of protection known to the law, that will enable him to realize the full intent of the constitution and enjoy the exclusive right to make, use and vend the invention.

Our patent system as it exists to-day is a grand structure, but it has some defects which are due principally to the fact that the demands made upon it by the development of our industries have far exceeded anything that the framers of the present law contemplated.

The patent law of to-day is substantially identical with the law passed by Congress in 1836. This law was revised in 1870, and codified in 1874, but few changes were made in it, and little if any protection was made, to accommodate the immense mass of business that has been cast upon the patent office, and some of the new features which were introducedhave been found work a hardship upon inventors rather than a benefit. So that practically we are working under a law formulated fifty years ago, when the work of the patent office for the whole year was something less than it is to-day for each week. Is it surprising, therefore, that the child should have outgrown its clothes? And this is practically just what has taken place A commissioner and a half-dozen examiners were quite equal to the task of examining intelligently four hundred and fifty patents a year, but the case is a very different one when the commissioner has under him something like two hundred examiners, and when the annual issue of the office is something over 25,000 patents.

If time permitted, I could show you how utterly impossible it is for the work of the patent office to be accomplished with any degree of satisfaction to the public under the prevailing organization, but I know that most of you are quite as well aware as I am of the defects which exist, and quite as much interested in removing them. I shall pass at once to the consideration of the measures of reform that seem desirable in the patent office.

I. THE PATENT OFFICE SHOULD HAVE THE EXCLUSIVE USE OF ITS BUILDING.—All those who have had any experience with the internal operations of the patent office are aware of the fact that this office is greatly cramped for space. The examiners are often crowded into rooms so small that there is scarcely space enough between the desks to move about. Many of the officers and employes are compelled to work in quarters that are unfit for human habitation, simply because there is no other place to put them; and the documents and records of the office are so crowded, and the places in which they are kept are so unfit for their accommodation that they are in constant danger of destruction. The patent office building was constructed with money, every dollar of which was paid to the government by patentees and applicants for patents, and yet the patent office is crowded into less than half of this building. The interior department, with its land office and Indian department, occupy the remainder.

The interior department should have separate quarters and the patent office should have the whole of its building, which will not more than accommodate it.

II. THE PATENT OFFICE SHOULD HAVE THE WHOLE OF ITS OWN INCOME.—For the past fifty years the patent office has paid all of its own expenses, has built its own building, and in addition to this has paid the government an annual revenue, which aggregates to-day without interest, something over three millions of dollars. And yet the most difficult task that the commissioners of patents have had to perform has been to induce congress to authorize the expenditure of a part of this revenue for the necessary expenses of the patent office. For the proper dispatch of the work of the patent office considerable additional force is necessary. The commissioner of patents should be authorized to expend the whole income of the office for its own expenses, and what was not spent should be set aside as a fund to be used for the benefit of the office at any time that it is needed.

III. EXAMINERS.—The staff of examiners in the patent office have charge of public interests of a most vital nature. They are the virtual judges of whether an inventor shall have a patent for his invention at all, and also of what kind of a patent he shall have in case they give him any.

It is therefore apparent that in order that they may perform their duties with intelligence and efficiency they must fulfil several conditions:

1. They must be thoroughly educated in the technology of the arts and sciences and in the patent law. Experience has shown that this training can only be acquired in one of two ways, either by systematic teaching or by years of experience in the practical work of the patent office; the latter method is the one now in operation, and it results in creating a class of examiners who are undergoing the process of education at the expense of the unfortunate inventor whose case may fall into their hands. The inventors of the country have a right to demand that this system of education of examiners at their expense be discontinued and a system adopted that will secure to the patent office a corps of examiners who will be thoroughly trained before they enter the office, and to the inventor the examination of his case by a man fully equipped to make such examination in the best manner.

2. Having obtained a staff of competent and thoroughly equipped examiners, they must be retained in office, so that the public may have the benefit of their services through a number of years. The army and navy have long since solved this problem by the exercise of a system of education, compensation, promotion and retirement on pay which fully secures these ends. Why should not that system so successful in one branch of the government service be established to secure similar and equally necessary results in the patent office?

3. The examiners should be relieved from all political influence. Civil service reform has attacked the question of political interference with patent office appointments with little success. The evils from this cause now existing are great and call loudly for remedy. The army and navy system has put those departments of the public service almost entirely beyond the reach of the politicians. Thus it should be with the patent office.

IV. SALARY OF COMMISSIONER OF PATENTS.—The salary of the commissioner of patents should be very high, so that every examiner may feel that if he is faithful and does his duty he may some day, in the natural order of promotion, reach a place of honor and large emoluments. This is the system of the army and navy, and in these departments it works admirably.

(*To be continued.*)

Incandescent Lamp Patents.

Concerning the suit for the control of electric incandescent lighting patents in this country, which has been begun in the United States circuit court between the McKeesport Light company, using the Edison patents, and the Consolidated Electric Light company, George Westinghouse, who is president of the latter company, authorizes this statement: "The filing of this bill is not a mere trick to worry the McKeesport

Light company or to agitate the patent question, but is brought for the purpose of settling the supremacy of the Consolidated company's patents once for all. It is not our intention to prevent the McKeesport Light and other Edison companies from doing electric lighting, but to compel them to buy their lamps from the Consolidated company, which claims the sole right to manufacture them, and whose policy is to sell lamps to everybody who wants them.

"The Consolidated company, in which Mr. Westinghouse recently purchased an interest and of which he was elected president, controls the Sawyer-Man patents, granted after five years of controversy in the patent office with the Edison company. The Westinghouse Electric company's alternating current patents have been recognized by the Thomson-Houston company, and the Westinghouse combination of companies practically controls long distance electric distribution for incandescent lighting.

"The Consolidated Electric Light company has purchased the Westinghouse company's lamp factory, and the suit is brought to settle finally whether the Edison company has any right to make incandescent lamps. We have no doubt it will be successful, in which event we will control all of the incandescent lighting in this country."

The Phenomena of Retardation in the Induction Coil.[1]

MR. WOLCOTT: I would like to ask Mr. Stanley if he has ever observed an effect in the reversing of magnetization of the cores other than Foucault currents. That is a sort of magnetic friction due to the mere reversal of polarity, independent of any induced current requiring an ex-

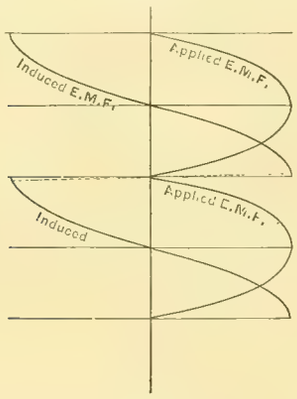

FIG. 2.

penditure of energy. I know that some years ago a French physicist experimented with alternating currents, using a copper core in one case and an iron core in another. Had the heating effect been due to the Foucault currents, the copper would have become much hotter than the iron, while, in fact, it did not get hot at all, but the iron got hot. I would like to know how much effect that has in practice on the alternating system.

MR. STANLEY: In measuring the waste in an induction coil we have found a very slight unaccountable waste, so slight, though, as to be almost unmeasurable. It depends somewhat on the number of alternations that are sent through the coil. With about sixteen thousand alternations a minute the temperature of the coil, if it were placed in a calorimeter, would indicate very nearly the amount of energy which was due to C^2R, or the heating of the conductor itself. The iron of the core of the converter or the induction coil remains at a very low temperature indeed. Of course, there is considerable radiation while in the air. Mr. Shallenberger, in Pittsburgh, has made several careful measurements, and he has found that there is hardly any perceptible loss from magnetic friction. I can well see that with a very high degree of magnetization, where the core was of a limited area, in proportion to the number of ampere turns surrounding it, that there might be a considerable waste due to magnetic friction or magnetic saturation, but with the induction coil, as made for the distribution of electricity for lighting purposes, this is very small. I can not tell you the exact loss, but it is very small.

MR. HOWSON called attention to the fact that a distinction had to be made between the true alternating current and the reversed or interrupted direct current.

MR. STANLEY remarked that for the purposes of distribution by means of transformers the interrupted or reversed direct current was of very little value.

MR. STANLEY: With your permission I will endeavor to sift out this subject a little bit more. As I understand it, the effect of joining the magnetic circuit around the primary and secondary induction coil is practically to reduce the wire, if I remember correctly, to about one-sixth. In experimenting with coils, to begin with, I took Faraday's ring and wound a coil on either side. The best coil I have ever seen consisted of a bundle of perfectly straight wires on which was threaded a lot of iron washers. This has the highest counter-induction per unit of length of any coil I have ever seen. In the Westinghouse company's system we get about two volts per foot of wire. This coil gave, if I remember correctly, about a volt to four inches. But it was impracticable to construct, as you could not make them fast enough. As I understand it the curves of electromotive force induced from an alternating current are these, Fig. 1. *A, B, C, D, E*, is a complete period of the curve of the primary or applied electromotive force. Now the induced electromotive force will be maximum at the time when the inductive eff ct of this primary current is a maximum; and the inductive effect of the primary current is a maximum when it changes from zero to any larger value.

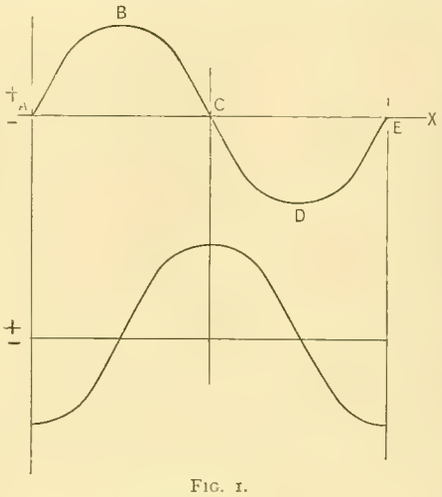

FIG. 1.

Consequently, the electromotive force of the induced current shown in the lower curve, Fig. 1, wil be a maximum at this time; and it will be a minimum when the inductive effect of the primary is a maximum, and that will be when the rate of change of the primary is the least, viz., at the crest of the primary wave *B* and *D*, we find that the same values of applied and counter electromotive force are just one-fourth of the whole period of phase of the current. That is with an alternating current. In the direct current we never can have as great an electromotive force induced in the secondary circuit because our primary circuit never passes the zero line. The curve of induced electromotive force in the case of a broken, direct or interrupted direct current I think is this, Fig. 2. As will be seen, the induced current will be of negative sign, while the positive current is going to maximum; and the induced current will be of positive sign, while the applied current is falling from the maximum.

Perhaps it might be interesting to illustrate the applications of induction coils for covering long-distance distribution. It is well known that the cost of a conductor varies inversely as the square of the electromotive force. The cost of the conductor for transmitting a given amount of energy will be, for 100 volts e. m. f., we will say, x dollars, while for a 200 volts pressure the cost will be $\frac{x}{4}$ dollars. Therefore, the economy of the alternating system over others is directly as the square of the ratios of their electromotive forces. But in order to cover enormous distances and to make the system as broad as possible. I devised another plan which may or may not be new. We are to apply it in Berkshire county, Mass., to distribute from a station over 6 miles of territory with a loss of 2 per cent. We have 100 horse power to distribute and the potential of distribution is to be 4,000 volts. Our alternating current dynamo is of 1,000 volts. In order to get the electromotive force up to 4,000 volts we simply wind one coil of wire and attach our dynamo to intermediate terminals of that wire, distant apart one-fourth of the entire length, as shown in Fig. 3. That is, the length included between the terminals is one-fourth of the whole length of wires wound on the coil. There is no secondary circuit whatever. Of course, there is an induced electromotive force upon every turn of wire upon that core of so many volts per turn. We

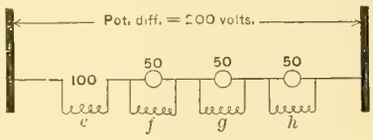

FIG. 4.

apply our electromotive force of 1,000 volts at those points in order to get 4,000 volts between the outside terminals. When we carry our current at this enormous potential over to the place where we wish to distribute we simply attach another self-induction coil similar to the first. On one-fourth of its entire length we tap out another circuit. That reduces the potential from 4,000 volts to 1,000 volts again. The maximum efficiency of an auto-converter, or converter of one coil, evidently is found in thecase where ratio of reduction is from 1 to2, or 2 to 1. If you have it in the ratio of 1 to 4, or 1 to 6, the saving isnot nearly as great.

MR. PRESCOTT: I was in the station that Mr. Stanley speaks about in the Berkshire hills a few days ago, and noticed that they had for the generators one omnibus wire running around the station, such as they use in the Edison station. But this omnibus wire was split in two, and each generator worked into its own circuit. I asked the attendant why the omnibus wire was not connected across, and he said that when they connected it across they were likely to burn out their armatures. I would like to ask Mr. Stanley if that is so?

MR. STANLEY: That is so, through an oversight in the construction of the dynamos in the early stage of the business We all have to learn some things, and the reason why it has been difficult to multiple arc alternating dynamos is that the phases have not been exactly the same. We made our dynamo pole pieces of cast iron. Those cast iron pole pieces did not measure to a thousandth of an inch the same width, and consequently the two phases of current, which ought to have coincided, did not coincide exactly, simply because of faulty construction. By tooling off and cutting the width of the pole pieces to an exact measurement, there is not the slightest difficulty in multiple arcing two, three or four alternating dynamos. I think a new feature in alternating currents, perhaps not well known to every one here, is the remarkable self-regulation of the alternating current machine. I can not speak of it fully because I have had very little to do with it. Another man is responsible for the beautiful work he has succeeded in getting. In Pittsburgh, a few days ago I saw a 2 500-light dynamo run by a 250 horse power engine, and 2,150 lights thrown off by a single switch. The rise in electromotive force was one volt. I submit, that in the present state of the art, it is impossible to construct a direct current machine which shall have anything like the self-regulation these alternating machines exhibit. The resistance at the commutator of a direct current machine would cause a greater variation of potential than was manifested in this machine I speak of. In the induction system we start out with an alternating current machine, in which we pretend to have at least a maximum loss of two volts in electromotive force in the dynamo with the proper regulation necessary to any machine. Towns are wired, at least I know of two pole lines which are wired for one per cent. loss of electromotive force, distributing electricity generally over an area of about a mile in radius. The actual loss in the mains is one per cent. In the induction coil, at full load, there is another loss of two per cent.

MR. MAILLOUX: I was expecting that somebody would refer to one of the features mentioned by Mr. Stanley this evening, which is to me one of the most interesting, if not, as it appears to me, of most interest from the theoretical as well as from the practical standpoint, inasmuch as it leads to a wide scope of applications. It is that system in which four lamps, *a, b, c, d*, were connected across the terminals

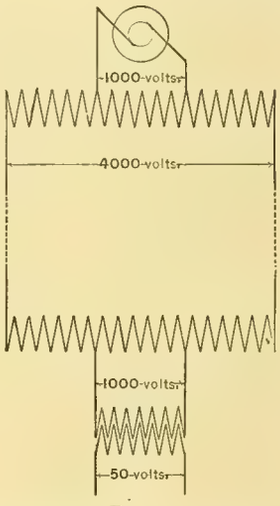

FIG. 3

of a constant potential alternating circuit, and in which the difference of a potential for a particular lamp cut out was taken up by the self-induction coil as *e*, Fig. 4. Now, I would like to ask Mr. Stanley whether the object of using that induction coil was merely to balance the other lamps, or whether it was expected that any energy would be saved by its use; in other words, whether the two lamps running with the circuit continued through the self induction coil would require less current than would the four lamps.

MR. STANLEY: The connection of the lamps in series in that way was for a street lighting system. In order to distribute lamps economically for street lighting purposes the plan adopted by Mr. Shallenberger was brought out. The shunted coil on the extinguishment of any one lamp prevents the rest of the lamps going out. For instance, there would be twenty lamps attached to a 1,000-volt circuit, each lamp of 50 volts. Now all those twenty lamps may go out or nineteen go out and the remaining lamp would be at approximate candle power; and yet the sum of the separate electromotive forces, measured by a voltmeter around the lamps and coils, is far in excess of the electromotive force that is applied to the outside terminals of the series.

For instance, there are four lamps connected in series. There was a lamp connected at *a*. That lamp is extinguished and in place of it there is a self induction coil *e*, Fig. 5. This series is connected to a circuit whose voltage is two hundred volts; a voltmeter connected to each one of these lamps will show for the lamps *b, c, d*, 50 volts each, and for the se f-induction coil, 100 volts. Now the sum of the interior electromotive forces here is two hundred and fifty volts. The same voltmeter will show an electromotive force of two hundred volts on the outside terminals. That is, the sum of the interior electromotive forces is greater than the applied electromotive force. I think that can only be explained by the retardation of the current producing the average electromotive force.

MR. PRESCOTT: In regard to the point that Mr. Stanley kindly replied to a moment ago, I would say that it is, of course, well underst od that if the time phases of any number of alternating current machines are identical there is nothing to prevent their being worked in a multiple arc. Now the question to my mind is, whether there is any

1 Discussion of Paper read by William Stanley, jr., before the American Institute of Electrical Engineers, Dec. 6, 1887, and published in No. 25 of the WESTERN ELECTRICIAN.

practical difficulty in getting those time phases the same. Of course, that includes not simply the electrical and mechanical construction of the machine, it requires them to be identical in that respect. Now I have only seen two Westinghouse stations, and in both of them each dynamo had a separate engine, and in both cases the machines supplied separate circuits. Is there any case of any plant now in operation where a number of machines are successfully run in multiple arc?

Mr. STANLEY: I think at Denver, Col., a station of five thousand lights is run with dynamos in multiple arc, although I am not sure. The Pittsburgh station has been run in multiple arc. Our policy is not to run in multiple arc. We prefer not to. There is no choice in the matter excepting only that of simple expediency. We construct the station switch-board so as to connect any circuit leading from the station to any dynamo without causing a flicker in the lights, and thus give the dynamo a definite load that you can read on the amperemeters. That seems to us to be a very satisfactory way to run. As the evening grows later lights are cut off, the circuits are transferred from a number of dynamos to perhaps a smaller number, and eventually down to one dynamo which runs all night.

The subject of multiple arcing of the dynamos comes so near the question of running alternate current motors that it is the same question practically, and I feel, perhaps, justified in explaining a little phenomon in that. If you take two alternating current dynamos and couple them together and start them up, one dynamo will fall into synchronism with the other. In order to have an alternating current motor it is necessary to have a direct current through the field and an alternating current through the armature. In order to get a direct current through the field you have got to have a commutator, which will produce the field current. This current in the field will rise from zero to a maximum value and fall again to zero value, but the armature currents will be above and below the zero value, as shown in Fig. 6. Now, notice, that at the time marked by the full vertical lines, there is no current flowing through the field, and there is no current flowing through the armature. If, then, we have an alternating current motor which is running with the exact speed and in conformity with the number of alternations of the dynamo which is applied to it, and have the phases of the two currents in exact synchronism, that is, with equal phases coming together at the same times, we will have absolutely no current in the field while there is no current in the armature of the motor. Now the commutation of the field may be outlined as shown where *C C C* indicate the commutator segments. There has been, until the motor arrived at synchronism, commutation at different points in the phases as at the dotted vertical lines. But when the motor runs at exactly the same speed as the alternating dynamo, there is no force then at work keeping the motor going. In other words, you can run an alternating current motor up to speed, but the moment it goes into absolute synchronism

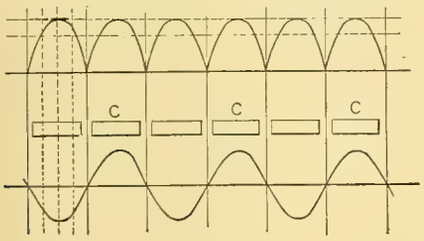

FIG. 6.

it will fall off again, and the consequence is that the alternating current motor will see-saw. There will be no power to continue its motion. Its speed will fall, and it will drop down to a lower number of alternations, but will rise again.

Mr. PRESCOTT: What is the effect if you have just enough work on to keep the speed down?

Mr. STANLEY: Then it will never rise to synchronism.

E. W. RICE, JR.: I would like to ask Mr. Stanley in reference to his last statement as to the motor. How much is the variation in speed, in percentage?

Mr. STANLEY: Of course, an alternating current motor in synchronism and kept there, runs at exactly the same speed as the alternating current dynamo does. If the motor is impelled to synchronism and beyond it, it will go to perhaps double the synchronism. If the alternating current machine is run 16,000 alternations per minute, the alternating motor if it goes beyond that number would never stop until it gets to 32,000 alternations. But the chief difficulty is that it does not develop any counter electromotive force under the conditions described, because it can not develop a counter potential unless it has at all times a constant field charge. As the current falls to zero, of course, it can not develop any counter electromotive force at that time. An alternating current motor has no efficiency of any consequence until it arrives at synchronism and becomes practically a dynamo running in opposition to the dynamo applied to it, at which time it has an enormously high efficiency with the most perfect self-regulation.

Mr. RICE: I hardly understand what Mr. Stanley means, in view of some experiments we tried recently. We had a self-exciting dynamo, and ran it in multiple arc with another self-exciting dynamo, and then threw the belt off. The current from the generator proper passed from the armature of the motor. We did not find any variation to speak of, and it ran perfectly in synchronism. It was a generator capable of giving out about twenty-five thousand watts. I then loaded it until the motor was giving out in the neighborhood of fifty thousand or sixty thousand watts without any change whatever in speed or any tendency to variation.

Mr. STANLEY: The gentleman said he had a self-exciting dynamo. Consequently he did not have an alternating current in the field. He had a direct current in the field, which never fell to an absolute zero of magnetization.

Mr. RICE: I thought the speaker said the motor had an isolated field?

Mr. STANLEY: It had an alternating field in which the magnetization periodically fell to zero. But, in the dynamo the gentleman speaks of, I understand the magnetization of the field is always the same. Consequently it was a true alternating current motor.

Mr. RICE: All that I can say is that we have run dynamos together for a period of twenty hours continuous running, and the loads seemed to be very equally divided when the speed was kept uniform. We have also experimented with motors and found no difficulty in that direction. While on the subject, I was very much interested in this system which Mr. Stanley attributes to Mr. Shallenberger. I think it is only just to Professor Thomson to say that the system was patented by him three or four years ago. He used almost identically that same arrangement, which consisted of placing the self-induction coil in place of the lamp, so adjusted that it would take just the current of the lamp. I do not know that that was the first time it was done, but so far as I know it was.

S. S. WHEELER: I would like to ask Mr. Stanley whether there are any losses on the line wire other than that of resistance—whether there is any current dissipated by retardation, self-induction, or anything of that sort.

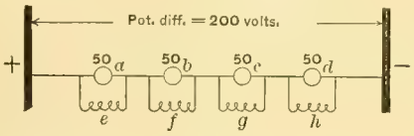

FIG. 5.

Mr. STANLEY: I was perhaps the worst frightened of any man who ever stood on solid ground when I read Prof. Hughes' lecture on self-induction. But the effect of self-induction which he described, and the measurements on which it was based, were made with a broken direct current. With the system that we use we have been able to find hardly any variation from the true Ohm's law, and all our wiring details are based on the assumption that the resistance is the ohmic resistance of the copper only. In the case where the wire goes around an iron core it is not necessary that there should be a loss of electromotive force. The electromotive force is merely retarded for a moment, and as soon as it has fallen to a value below that of the charged magnetism, the stored electromotive force is all returned to the circuit. I think there is nothing so generally misunderstood as the loss of electromotive force on iron cores.

Mr. MAILLOUX: I do not think Mr. Stanley exactly answered my question, and the remarks made bring us back to it again. The question is whether in that circuit that he speaks of in which an induction coil is substituted for a lamp, whether the loss of energy—in other words, the expenditures of energy, across that line is different in the second case from what it would be before that induction coil had been substituted. If, as Mr. Stanley argues, the effect of self-induction is simply to retard the electromotive force, then evidently we still have electromotive force there, and if it does not absorb electromotive force or cause no loss, then we should take less energy than would be accounted for by that which would be absorbed in the three lamps, plus that absorbed in the ohmic resistance, as he calls it, of the self-induction coil. For we must remember that the amount of energy required at the terminals of the induction coil is not as much as would be represented by $C^2 R$. It is $C^2 R$, plus a certain quantity which represents the work done in the induction coil in overcoming the counter-electromotive force of the coil. Now, then, it is interesting for us to know whether in that case the expenditure of energy was the same whether the induction coil was on or whether the four lamps were burning at one time. I incline to the opinion that it must have been the same, and that consequently there must have been a certain amount of work which was absorbed and dissipated by the self-induction coil.

Mr. STANLEY: The energy on the lamp is exactly the same. If it were not the lamps would grow brighter. The potential on them is constant. The current going through them remains constant, or they would not be of the same brilliancy. The self-induction coil does waste some energy, but it has the effect of storing energy for a brief interval of time and then returning it upon the circuit. As to the invention of the self-induction coil for this purpose, I have the very highest regard for Professor Thomson and always had, but if I remember correctly, the patent that Mr. Rice refers to is not for this purpose. It is for cutting in a coil. This is a very different invention. This is a coil always in circuit to do this work, while the coil Professor Thomson devised is cut into the circuit.

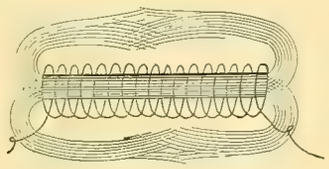

FIG. 8.

Mr. MAILLOUX: I would like to state then that my conviction appears to be upheld by Mr. Stanley, that, the energy being the same, this induction coil represents nothing more than resistance. It takes up a certain amount of energy which a certain idle resistance would clearly absorb. If we were to replace that self-induction coil by another one having no self-induction, but a larger resistance, so that the circuit going into that resistance would absorb the same number of watts, then we would evidently have the same energy absorbed as we have by that induction coil. So that I do not see that the induction coil in question does anything more than to replace a lamp that is put into that circuit. The case is exactly analogous to that of an electric motor that would be placed in circuit. The amount of energy absorbed by an electric motor is the difference of potential at its terminals.

Mr. WETZLER: It occurs to me that perhaps that this phenomenon might be due to an error, or a peculiarity, of the measuring instrument employed. Mr. Stanley said that he employed a Cardew voltmeter. I would like to know whether he ever applied the electro-dynamometer for that purpose.

Mr. STANLEY: The electro-dynamometer is a very unfortunate instrument to use with an alternating current, as its reading is changed by a slight fluctuation in the alternations. The Cardew voltmeter, which is dependent on the amount of heat produced, is entirely independent of the alternations. Perhaps I can explain that. The coil is acting exactly as a dynamo would act in series and it chokes down the current in direct proportion as the resistance in this part of the circuit is raised. The average electromotive force at the terminals of the coil, however, is greater than would seem to be warranted by Ohm's law.

Mr. HOWELL: Mr. Stanley said that inasmuch as the current was constant, as shown by the lamps, that is, the current in three lamps was the same as the current in four and that the electromotive force acting on the circuit was also constant, that the energy was constant in the circuit. I would infer then that $C E$ is the measure of energy in the alternating current. Is that a correct conclusion?

Mr. STANLEY: No, sir; that was a slip of the tongue perhaps on my part; but it is a most unreliable quantity. The energy on the three lamps is the same as the energy on the three lamps before. I think in reality there is very little waste of energy. But there is an apparent amount of energy wasted there—that is $C E$ of the coil. This is apparently as much as the energy expended on the lamp.

Mr. HOWELL: I think that that diagram is a very good illustration of the fact that $C E$ is not a measure of the energy in alternating circuit, because you have only a value for C there, and the value of the energy in that circuit would be $C \times 200$. Now that is the sum of the energies in three lamps and the coil, and in each lamp it would be $C \times 50$, and in the other it would be $C \times 100$; so that the sum of these energies is not the same as the sum of the whole circuit computed the other way, which shows that $C E$ is not the measure of the energy of the circuit.

I would like Mr. Stanley to demonstrate why the current

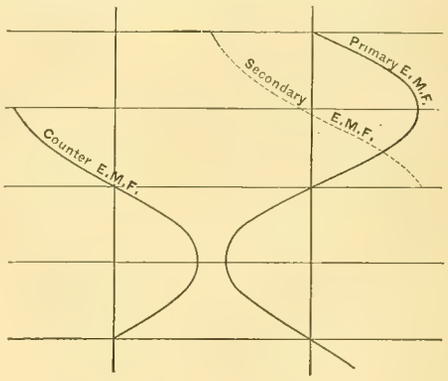

FIG. 7.

in the secondary increases, or why an increase of current in the secondary increases the current in the primary.

Mr. STANLEY: I think that is very easy to understand from the diagram, Fig. 7, of the counter-electromotive force, providing no current is flowing through the coil. The secondary electromotive force will of itself induce another electromotive force, and so we might go on inducing forever electromotive force. We can not only transform energy once; we can transform it a thousand times. Now the secondary electromotive force will develop a counter-electromotive force on the primary circuit, and that will be still one-quarter of a period later. Notice that I have drawn these curves directly opposite. It exactly opposes the primary electromotive force at the same instant of time. Now, when the current is abstracted from the coil, this is no longer the position of the secondary electromotive force; it is shifted on. Consequently the counter-electromotive force no longer opposes the primary electromotive force at the maximum time of the primary electromotive force, and consequently its value as a counter or opposing e. m. f. is very much lessened. You have asked me a difficult question.

Mr. WHEELER: I would like to return to the three lamps in the induction coil, because I want to ask this question. Mr. Stanley stated, if connections were made between the main conductors we would have 200 volts; in Fig. 5, the terminals of coil *e* would measure 100 volts, and *f g h* would measure 50 volts, making a total of 250. Now I would like to ask Mr. Stanley what he would get if he measured the potential between the conductor and the right-hand terminal of lamp *b*.

Mr. STANLEY: I have never tried it.

Dr. VANDER WEYDE also described some of his early experiments with the induction coil, and exhibited a number of early models, in which attempts are made to completely close the magnetic circuit of the coil. One of these, Fig. 8, was made with long wires for the core, which wires were then bent over the sides and completely inclosed the coil.

Death of Franz Carl Guilleaume.

The death of Franz Carl Guilleaume of the well-known firm of Felten & Guilleaume at Koln, Dec. 1st is announced.

Incandescent Lamps — A Note On the Conductivity of Glass.[1]

BY NELSON K. CHERRILL.

Prof. Ayrton, in his "Practical Electricity," page 271, says that the resistance of dense flint glass increases very rapidly as the temperature diminishes below 60° C. From this it might perhaps be inferred that the resistance might be expected to diminish as the temperature rose above 60° C.

My attention was first directed to this subject some two or three years ago by noticing a very curious and persistent fault in a number of incandescent lamps under my charge at the time. One of the platinum wires of these lamps was almost invariably blackened where it passed through the glass. For a long time this defect was attributed to careless manipulation on the part of the glass blowers; it was thought they had not taken care to see that the wires were really clean when put into the glass. This possible cause of the failure having been eliminated without affecting the result, I was led to note that the blackened wire was always on the same side relatively to the arrangements for supplying current to the lamps during the pumping process. This led to the idea that perhaps glass was not, after all, under certain conditions, such a perfect insulator as was usually supposed.

A soft, rich lead glass was being used for the manufacture of the bulbs at that time, and I found that—especially after recent working—a very moderate rise in temperature produced such a fall in resistance that a very appreciable amount of current would pass through the glass, the glass between the platinum wires acting as a shunt to the carbon of the lamp during exhaustion. This led to the supposition that the blackening of the wires was caused by a deposition of lead from electrolysis of the glass. The current used had an e. m. f. of about 100 volts.

I tried the resistances of the glass between two platinum wires, sealed in in the ordinary manner, but without any carbon filament, and I found that immediately after sealing in—that is, as soon as the bulb was cold—the resistance did not amount in many cases to more than 15,000 ohms, but the next day it had risen enormously higher.

When, however, the glass was reheated to only a moderate extent—that is to say, far below its melting point—the resistance was very largely decreased, to be again increased on cooling; but, according to my observations, the full or normal resistance is not attained—at any rate, with lead glass—for many hours after the glass is cool. It would seem as if some action of crystallization goes on in the glass, even after cooling, which changes the molecular arrangement.

Lead glass is not peculiar in exhibiting this property of becoming, to a very appreciable extent, conductive under the influence of moderate heat.

An interesting experiment can be tried with a very small battery and galvanometer by simply fusing a bead of glass upon a wire, and inserting a second wire into the bead, making up the circuit so that the current passes through the glass. I used one cell of Leclanché battery and an ordinary astatic galvanometer, with a bead of glass about the size of a small pea; the needle of the instrument flew to its stops as soon as the bead, held in the blow-pipe flame, assumed the faintest redness. By manipulating carefully the bead can be drawn out, and the effect on the galvanometer may be noted at the same time; in this manner I got a clear deflection of 10 degrees of the scale through a filament of glass three-eighths of an inch long with only three cells of battery. Hard German glass behaves just in the same manner. I have tried many kinds of glass and they all give the same result.

There is one point in connection with this matter which may be worth consideration. Glass is usually looked upon as a *solid* substance, and it is certain that at the temperature at which the electrolytic action I have referred to in the manufacture of lamps took place the glass was far from being in a "plastic" condition; and yet in a solid substance we have here a movement of the constituent molecules into new positions, called, I think, in electrolysis "the migration of ions," the "solidity" of the material being maintained all the time.

[1] London *Electrician*.

The Overhead Conductor Electric Railway Co.

The Overhead Conductor Electric Railway company, of Pittsburgh, Pa., has been organized with the following officers: President, George Westinghouse Jr.; vice-president and secretary, Thomas B. Kerr; treasurer, John Caldwell; directors, George Westinghouse Jr., C. H. Jackson, George H. Christy, H. H. Westinghouse and Thomas B. Kerr. The design and scope of the company can best be explained by a quotation from the catalogue just issued:

"The Overhead Conductor Electric Railway company has acquired the entire right, title and interest of Joseph R. Finney and his assignees, in all his inventions relating to electric railway service, and in the patents granted therefor. These patents were granted after a most thorough investigation, and are believed to cover broadly every form of apparatus for supplying electricity to electric machinery upon moving vehicles, making use of travelers or contacts running upon overhead conductors.

"The Overhead Conductor Electric Railway company is now prepared to issue licenses to railway companies, contractors and others, desiring to use its patented inventions, either upon old or new roads, at the uniform rate of $250 per car.

"Notice is hereby given, that in order to protect our licensees in the enjoyment of their rights, this company will institute legal proceedings against all makers, sellers or users of infringing apparatus."

CORRESPONDENCE.

New York Notes.

NEW YORK, Dec. 17.—In the December number of the monthly issue of the *Transactions of the American Institute of Electrical Engineers* appears for the first time an index of current electrical literature. Classified under various headings is a list of all editorials and other original articles of interest to electricians, that have appeared in scientific and other periodicals since the first of October. Such lists will have place in all future issues of the *Transactions*, and their value for reference is apparent. In the first instance some three hundred articles are referred to. They will be carefully compiled by the secretary of the institute, Ralph W. Pope, and we are glad to be able to state that at the end of each volume of the *Transactions* a complete classified list will be published, for convenient and permanent record It is only to be regretted that such valuable indexes do not date back of October 1, 1887. In future numbers there will also be printed a complete list of the journals referred to, with addresses of the publishing houses and prices.

It is expected that the special meeting of the institute called for next Tuesday, the 20th inst., will prove unusually interesting. Arthur Steuart, of Baltimore, legal counsel of the National Electric Light association, will read a paper entitled "Revision of the patent laws." All of the leading solicitors of patents in the United States have been invited to attend, and many have signified their intention to be present and take part in the discussion. This question of reform in the patent office and revision of the patent law is one of the utmost importance to the electrical profession, and as there is a wide difference of opinion as to just what action should be taken, a thorough discussion of the question by competent men will be most timely and valuable.

The assembly telephone investigating committee closed their labors in New York on Wednesday. They take away with them a record of a mass of testimony by friends and enemies of the present telephone system, and the question now is—what can they do about it? Some consider the telephone a necessity, others a luxury, and others a nuisance. But the point most clearly brought out, as in all other telephone investigations that we know of, is that most of the money made in the business is made by the American Bell Telephone company of Boston, and that they are protected in their exactions of royalties by laws of patents and contracts that leave a customer, up to the present time, only the option of accepting their terms or else going without telephone service. And this is probably just the position that the customers will be in after the committee have reported the results of their investigation to the assembly at Albany.

Cars have been fitted up with motors, and rails have been laid in the streets, for the Fulton street electric railway, but unfortunately the road cannot be put in practical operation at once. The reason for the delay, according to President Hazard, is a failure on the part of the company to make reasonable terms with the Bleecker street road people for the use of the latter's track for a short distance, and it may be that the legislature will have to be resorted to for relief. The company asserts that by using electric motors it can afford to pay the city thirty-five per cent of the gross earnings and also pay a reasonable rental for the use of tracks belonging to other roads. The Bentley-Knight system will be used. It is claimed that the motor is powerful enough to pull the car on to the rails again if it should run off the track, even if loaded with passengers. The road will probably be in operation by spring.

A barrel of chemicals exploded this week in the Brooklyn factory of the Consolidated Electric Light company and caused quite a panic among the men and girls employed in the building. Fortunately no lives were lost, though several of the girls were cut and bruised by falling down stairs. There was about $50,000 worth of electric lamps and other stock in the building at the time, and considerable damage was done by the fire and water, but it was fully covered by insurance.

The Electrical Subway commission, in their report to the mayor, states that since October 19th, there have been 350 miles of wire removed. The commissioners claim that, although the police department is willing to remove its wires from the telephone company's poles, so that the poles may be removed, they are unable to make any move through lack of an appropriation of $5,000 necessary to complete the work. Legal proceedings have been ordered by the commission against the B. & O. Telegraph company for continued neglect of the law relating to the burying of the wires.

The stock market has been very much strengthened by the action of the directors of the Western Union Telegraph company in voting to increase their dividend to 1¼ per cent. According to the figures given out by the company the gross revenue for the current quarter will be the largest ever earned in any three months.

E. Berry Wall, known in New York as "King of the Dudes," was married yesterday in Washington. Before leaving the city to meet his bride he wisely arranged with Hazazer & Stanley to fit up his house with a complete system of electric calls, including a clock burglar alarm.

Chas. A. Schieren & Co., report this week sales of leather link belting, to be used for dynamos, to the following parties: Edison Electric Illuminating Co., Brockton, Mass.; Burlington Gas Light Co., Burlington, Vt.; Wilmington City Electric Co., Wilmington, Del.; Pawtucket Electric Light Co., Pawtucket, R. I.; Wachusett Electric Light Co., Fitchburg, Mass.; Sayles & Jenks, Warren, Mass.; Lawrence Electric Light Co., Lawrence, Mass. A.

Detroit's Budget.

DETROIT, Dec. 17.—The annual meeting of the Michigan Telephone company was held on the 15th. Among the directors present were: Robert T. Lincoln, Judge Isham, Norman Williams, Messrs. Sprague, Bishop and DeKoven all of Chicago. The following officers were re-elected: James McMillan, president; Norman Williams, vice-president; Hugh McMillan, secretary and treasurer; Wm. A. Jackson, managing director.

Articles of association of the Michigan Electric company were filed with the county clerk on Thursday; capital, $50,000; paid in, $34,500. The incorporators are: Edwin W. Neff, of Chicago, 400 shares; Fred H. Seymour, 400 shares; John C. Grant, 400 shares. The company propose to manufacture and sell electric and pneumatic apparatus; also to push the Johnson heat regulating apparatus. This is the invention of Professor Johnson, of Milwaukee, and consists of a thermometer located in each room of a

building, so arranged that it can be set for any desired temperature. If the heat in the room varies even one degree—fall or rise—the regulator will be automatically opened or closed by an electrical attachment. A Chicago and Milwaukee syndicate, control the patent, the Michigan company having only the rights for this state, and Lucas County, Ohio, including Toledo.

The Electrical Accumulator company is placing its storage batteries in the sleeping cars now being built at the Pullman shops.

Sturgis, Mich., will be lighted by electricity by January 1st, having contracted with the Edison company for the work.

The Brush company will light Detroit for the next three years, the council having passed the resolution providing for the lighting, over the mayor's veto. C.

From the Pacific Slope.

San Francisco, Dec. 12.—Motor business in San Francisco is steadily on the increase. The California Electric Light company were negotiating for a large piece of property at North Beach, but the Electric Telpherage company got in ahead of them.

The government cable between Black Point and Alcatras island is being repaired. The large number of ships anchoring in that vicinity play sad havoc with the cable.

A decree dismissing the suit of the Sunset Telephone & Telegraph company against the ships Enoch Talbot and Carl Frederick was entered on the 9th in the district court. The suit was brought to recover damages, caused by the anchors of the vessels fouling the plaintiff's submarine cable.

The San José Motor company tested their engines on the 7th, and everything worked satisfactorily. Their double track is complete half way to Santa Clara, and for the remainder of the distance a single track is laid. The first trip is expected to be made on New Year's day. The generator and electric machinery for this road have been delayed a considerable time on the road, and, by the way, it may be said that a great deal of fault is found by persons expecting freight from the east, as freight is delayed from two to four months by the blockades on the road.

At Nevada City a subscription is being taken up to erect a 200 feet tower in the center of that town.

At San Diego, Cal, December 7th, a sailor of the United States ship Ranger, found a new use for the Jenney towers. When the trimmer ascended in the morning to trim the lamps, he was surprised to find one of Uncle Sam's men sound asleep there.

The San Diego Gas & Electric company has paid a dividend of 25 cents per share. This plant is but two years old. S.

THE ELECTRIC LIGHT.

The new building of the Chicago Telephone company is being wired for Edison incandescent lights.

Benson Bidwell of Chicago has invented a dynamo and electric motor, which, it is claimed, will run continuously twenty-four hours without overheating or which are not affected by moisture or water.

Johnstown, N. Y., has voted for electric lights.

Madison, N. Y., is agitating the electric light question.

The Asheville, N. C. Electric Light company is purchasing machinery to enlarge its incandescent plant.

The electric light plant at Cadillac, Mich., is running at its full capacity, and another dynamo will probably soon be put in.

H. A. DeKay is negotiating for the erection of an electric light plant at Goldsboro, N. C.

An offer has been made to erect an electric light plant at San Angelo, Tex., in connection with the water works.

At Altoona, Pa., the Mountain City Electric Light company is erecting a $35,000 plant. The president is Louis Black; secretary, W. H. Mackley.

Hamilton, Ont., is to have twenty-one additional electric street lamps which are to be put up immediately.

The Ware, Mass., Electric Light company, recently incorporated, has contracted for a plant with the Thomson-Houston Electric Light company of Boston.

H. H. Corson has ordered machinery for the Thomson-Houston electric light plant at Bristol, Tenn. A local company has been formed to purchase the plant after it has been put in successful operation.

The enormous building now being erected in Manchester, England, for Buffalo Bill's wild west show, is to be lighted by 25 arc lamps besides a large number of smaller electric lamps.

The viceregal palace at Simla, India, is to have a very extensive installation of electric lights. The electric light has also been introduced into the East India railway collieries at Giridhi, and marks the opening of a new era in Indian mining. The miners are delighted with the innovation.

Two of the British royal yachts, the Osborne and the Victoria and Albert, are to be lighted by electricity; the former in full, and the latter in all except the state apartments.

Gastein, Austria, is to be lighted from a central station, by the incandescent system, arc lights being inapplicable on account of the irregularity of the streets. The motive power is to be derived from a cascade in the river Gasteiner Ache, which is estimated to represent 1,500 to 2,000 horse power; the plant consisting of a Girard turbine of 125 horse power, and four dynamos, each of 20 units capacity.

THE ELECTRIC MOTOR.

The directors of the Broad Gauge Street Car company of Des Moines, Ia., say they will adopt the electric motor.

Stratford, Ont., wants an electric street railway.

The Marquis of Salisbury takes great interest in electricity, and is employing it on his estate at Hatfield to work the elevators for building the hay and corn stacks.

John D. Nicholson, John H. Dalzell, W. H. McElroy, George B. Hill, and Samuel Diescher, are the leading men of the National Electric Railway company, organized at Pittsburgh, Pa.

The subject of electric tramways is attracting attention in India, and arrangements have been made in London to introduce the new tramway system into Madras.

A new electric locomotive has been built at Berlin. The motor is speeded at three hundred revolutions, and connected with the axles by spur gearing. Electric power is supplied by a battery of E. P. S. accumulators, giving 200 volts and a maximum rate of discharge of 40 amperes. The total storage capacity is 300 ampere-hours, and the estimated speed 7½ miles per hour.

Siemens & Halske of Berlin are manufacturing small motors of one-tenth horse power to 2 horse power for use in private houses, the electricity to be obtained from electric supply stations.

THE TELEPHONE.

Recently a musical treat was enjoyed by persons in the Meriden, Mass., New York and Philadelphia offices of the long distance telephone lines. A violinist in the Meriden office played to the delectation of listeners in the other offices, and Philadelphia responded with some pretty airs from a music box.

The number of telephones in use in the United States is 341,670, and the gross income from the same for the year 1886 was $11,150,000. The expenses were $7,000,000 and the net earnings were $4,150,000. The number of miles of wire is 128,231. The subordinate telephone companies obtain $26.81 net profit per subscriber, after paying $14 royalty to the parent company and all expenses of the business.

A Harrisburg dispatch announces that Daniel Drawbaugh, of Drawbaugh telephone renown, has completed an electrical contrivance which he maintains will detect the approach of an army or of ships on the ocean within a distance of ten miles from the location of the instrument. Mr. Drawbaugh says the nearness of troops would be indicated by a peculiar motion of the instruments by the vibration of the earth. In the case of the approach of a vessel, he states that the resistance of the water to the vessel causes sufficient friction to establish communication with the contrivance.

A telephone line will be established between Davenport and What Cheer via Muscatine and Oskaloosa, Ia.

B. F. Blackall, formerly superintendent of the telephone office in Rochester, N. Y., has been engaged for some months past in establishing a police patrol system in Toronto.

The New York legislature telephone investigating committee, met at Rochester, N. Y., on the 16th inst. M. J. Meyers of Syracuse was called upon to tell all he knew about the telephone business. He is engaged in the district telegraph and electrical supply business at Syracuse, and was treasurer of the telephone exchange of Onondaga county, which had a nominal capital of $40,000. The company purchased the plant of the Edison company, which was then in operation, paying for the Syracuse exchange $10,850.95, an average of $27.50 for each subscriber. Mr. Meyers continued: "The last year I opened the exchange it had 640 subscribers; there were about three and a half subscribers on the combination wire. I think our service was as good as the New York service is. My exchange in round numbers cost $33,854, including the purchase of the Edison plant. That accommodated 640 subscribers. The cost of construction per subscriber was less than $30; we charged $36 on combination wires, and that rate we never changed to old subscribers. We afterwards charged $42 and $48 to subscribers without regard to distance. For separate wires we charged $48 in the quarter mile radius, and $12 for each additional half mile. We paid the American Bell company a royalty of $12.50 per instrument. The average expenses per subscriber were $25 41, and the rental average was $42.41, leaving us a nominal profit of $17 per subscriber. My plant was bought by the Central New York company last June. We had perhaps 100 magneto bells in use and never used one up. Some of them were in use four years. We have one wire in use put up ten years ago; it is number 10 galvanized wire, and appears to be as good as ever. My experience is that corrosion does not impair the conductivity of wire; as long as it is strong enough to bear the strain it works well. My estimate of the annual depreciation of telephone plant, excluding the cost of repair and maintenance, would be not more than 5 per cent. The Syracuse plant is now the best I ever saw."

THE TELEGRAPH.

A military telegraph line in India has been completed between Jamrood and Lundi Kotal to within 140 miles of Cabwl, through the Khyber pass.

The Belgian cavalry are to be furnished with telegraphic experts, selected from their own ranks and trained for the service at the various railway telegraph offices in garrison towns.

The regular quarterly meeting of the directors of the Western Union Telegraph company was held in New York on the 14th. President Green submitted his quarterly report, which shows: Surplus Oct. 1, 1887, $7,354,569.35. The net revenues of the quarter ending Dec. 31st, based upon nearly completed returns for October, partial returns for November, and estimating the business for December, will be about $1,500,000; add surplus Oct. 1st as above, $7,354,569.35, making a total of $8,854,569.35, which, appropriating for interest on bonds and sinking funds, $142,650, leaves a balance of $8,711,919.35. It requires for dividend of 1¼ per cent. on the capital stock $1,077,343.75, deducting which leaves a surplus, after paying dividend of $7,634-575.60. The report then goes on as follows: The gross revenues will be the largest ever earned in one quarter. But little reduction in the expenses of the Baltimore & Ohio system could be made before Dec. 1st, and it will require a little further time to realize the full benefits of the economies of the consolidation. In view of the preceding statements the committee recommend

the adoption by the board of the following: "*Resolved*, That a dividend of 1¼ per cent. on the capital stock of this company be hereby declared, payable on and after the 16th day of January next, to stockholders of record at the close of the transfer books on the 20th day of December, instant." The report was adopted.

NEW ENTERPRISES.

A. W. Wolf will build flats at 239-41 North Curtis street, Chicago, to cost $8,000.

Architect P. Hale has planned for F. Messick stores and flats at 3001-3 Cottage Grove avenue, Chicago: estimated cost, $18,000.

Architects Ostling Bros. report plans for a $10,000 store building at 254 and 256 North Market street, Chicago, for H. F. Lundgren.

F. L. Brand will erect after plans by architect C. M. Palmer a $10,000 store and flat building at 1223 and 1225 Wabash avenue, Chicago.

Eckert & Swan are preparing to build a large warehouse 140 x 90 feet, on Market, near Randolph street. It will cost $150,000.

N. R. Wakefield will build a three-story and attic house on West Monroe street, Chicago, near Hamilton avenue. It will be of pressed brick and brown-stone trimmings, to cost $18,000. O. J. Pierce is the architect.

Conrad Seipp is to have a $150,000 residence on Drexel boulevard, near Forty-sixth street, Chicago. The structure will be 75 x 90 feet, three stories high.

Clarence Hoover of Seventh street and Euclid avenue; Kansas City, Mo. will erect a $7,000 residence. Electric bells will be put in.

A new opera house is in prospect at Helena, Ark.

The Electric Light company of Owensboro, Ky., are in want of a duplex boiler feed pump.

Miscellaneous.

C. A. Faure, the inventor of the secondary battery which bears his name, claims to be the originator of the Cowles aluminium process. He says that he sold to the Cowles brothers a patent in 1882, but that the process in question was patented by him in November 1883, and that during the past year he has been operating quietly in England preparatory to placing his process before the public.

In a paper read at the meeting of the British association at Manchester in September last, the Hon. R. Abercromby maintained that the circulation of the air in thunderstorms is around a long horizontal axis instead of a short vertical one as in cyclones and tornadoes. Perhaps we may infer from this, that the rolling movement seen on the edge of the advancing thunder cloud is an effect of this horizontal rotation.

Tests, recently made in the British navy, demonstrate the possibility of signaling by flashing the Morse signals from a powerful electric light on the clouds. Signals flashed in this way from the ship Espoir, were read on the ship Orion in the harbor of Singapore, 60 knots distant, but the reply was not received by the Espoir, so that the experiment was only partially successful. The success of the system depends largely on the state of the atmosphere and position of the clouds.

The Boston Club's Greeting.

The following self-explanatory telegram from the Boston Electric club was received too late to be read at the last meeting of the Chicago club:

To the President and Members of the Chicago Electric club:

Knowing that this evening your club meets in its new rooms we send you cordial greeting and unbounded wishes for prosperity. We are about listen to a lecture from Professor Dolbear and wish you also could enjoy the intellectual symposium.

FRANK RIDLON, *Prest.*
A. V GARRATT, *Secy.*

Personal Paragraphs.

F. D. Helmer, local manager of the Vacuum Oil company, and family are in Rochester, N. Y., visiting relatives.

Robert Cartwright, representing the Woodbury Engine company of Rochester, N. Y., was in the city the early part of the week.

Business Mention.

The Railway Telegraph Supply company, M. A. Knapp, manager, Chicago, is turning out some very handsome magneto boxes for the Cushman company. The boxes show a rare and beautiful combination of natural cherry and Mexican mahogany, making a charming contrast and producing an artistic effect.

The Van Depoele Electric Mfg. Co., of Chicago, are working upon five 80 horse power generators and four 100 horse power generators, to say nothing of orders that are awaiting shipment, orders that have been received and not put into the shop, and all their other work. A 250 horse power generator was one of the striking sights of their shops to the visitor who was admitted to the ground floor last week. For large work the Van Depoele shops are noted, and the visitor who secures the opportunity to see it in construction, can not but marvel at the magnitude of the machines turned out here as compared with what may be seen in the shops of other electrical concerns.

E. Major, chief engineer of the Powers hotel, Rochester, N. Y., writes as follows regarding the new high speed engine of the Woodbury Engine Co. of the same city: "We have one of the new Woodbury automatic high speed engines in this house running one of our Edison dynamos. The engine is 10" × 14", speeded at 280 revolutions per minute, and was put in to take the place of an eastern automatic engine with the same diameter of cylinder. It is greatly admired by all who see it in operation for its smooth and noiseless running. I can only say in regard to its regulation that it is simply perfect, in spite of the fluctuations of load and steam pressure. It is impossible here to keep boiler pressure uniform, and we have from 50 to 70 pounds, but the speed of engine remains constant at all times. It was on this point that our former engine failed to give satisfaction, but the Woodbury gives us no trouble and is the engine for me."

The Thomson-Houston Electric Light Co., of Buffalo, have contracted with the Callender Insulating & Waterproofing Co. for between twenty-five and thirty miles of their Trinidad line wire, to be used for all of the overhead circuits they are now putting up. Another company who have adopted this wire is the Columbus, Ohio, Electric Light & Power Co. This would seem to be of interest as indicating the beginning of the condemnation of Underwriters wire, and the substitution of something better in its place.

The Waterhouse system in operation at the electric lighting station of the Schuyler Electric Light company, at Newark N. J., and doing commercial lighting in the city, is driven by Ball engines, 12"x12", making 270 revolutions, with 85 pounds of steam at boiler and about 80 pounds at engine, cutting off at one quarter stroke, with a mean effective pressure of 40 pounds in cylinder, giving 74 indicated horse power. One of these engines is driving several Waterhouse dynamos operating circuits of 112 lamps, producing a current of 9¾ amperes and 45 volts. The other engine is driving a second set of dynamos operating circuits having a total of 115 lamps, of the same current strength and voltage. This is equal to .67 of an indicated horse power to each lamp, inclusive of street circuit, a very remarkable showing for economy. At the Harlem station, in New York, they have 121 commercial lights, of 8½ to 9 amperes — consuming ⅝ of a horse power each. When a system can produce these results, and the white, steady brilliant light for which the Whitehouse system is renowned, the company representing it is to be congratulated. They are also claiming to obtain such a high efficiency for their dynamos that they do not hesitate to guarantee twelve 16 candle power incandescent lamps to the horse power at the pulley of the dynamo.

Electrical Patents.

Issued December 13, 1887.

374,580. Revolving Electric Hammer Tool. William G. A. Bonwill, Philadelphia, Pa.

374,581. Electric Temperature-Indicator. Jeffery C. Boyle, Brooklyn, N. Y.

374,621. Electric Motor or Dynamo Electric Machine. F. Jarvis Patten, Fort Sidney, Neb.

The invention relates to the field-magnet poles, armature-commutatios and connections. The fourth claim is: "In a dynamo electric machine or motor, a tri-poler or three coil armature placed between terminal field-magnet pole pieces that extend over unsymmetrical arcs of the armature circumference."

374,631. Galvanic Battery. James Serson, Boston, Mass.

374,640. Electric Fuse. Karl J. Sundstrom, Dover, N. J.

374,652 Circuit-Breaker. Charles B. Bosworth, Everett, Mass.

374,669. Galvanic Battery. Catherine R. Freeman, Hartford, Conn., (Administratrix of Joseph Freeman, deceased).

374 673. Automatic Circuit-Closer for Secondary Batteries. William W. Griscom, Haversford College, Pa.

374 711. Armature. Henry B. Slater, Detroit, Mich.

374,728. Dynamo Armature. Edward N. Bliss, Newark, N. J.

374,733. Railway Switch. Stanley C. C. Currie, Philadelphia, Pa.

374,738. Conduit for Electric Conductors. Edward E. Greene, New York, N. Y.

374,747. Electro-Medical Apparatus. John S. Muir, Hanford, Cal.

374,778. Electric Generator and Motor. Albert F. Congdon, Philadelphia Pa.

374,792. Conduit for Electrical Conductors. George D. Holt, Minneapolis, Minn.

The conduits are arranged one within another, and are progressively smaller in cross-section. Openings are provided at the top for affording access to any conduit.

374,842. Safety Strip for Electric Circuits. Philip Lange, Pittsburg, Pa., and Oliver B. Shallenberger, Rochester.

374,843. Electric Coupling Device. Philip Lange, Pittsburg, Pa.

374,850. Method of Testing Electric Lamp Globes. Charles F. Reinmann, Pittsburg. Pa.

The lamp globes, previous to their exhaustion, are placed under water after they are affixed to their supporting forks. Air under pressure is then forced in, and any leak or imperfect joint is indicated by bubbles rising on the surface of the water.

374,858. Dynamo Electric Machine. George Westinghouse, Jr., and Henry M. Byllesby, Pittsburg, Pa., Oliver B. Shallenberger, Rochester, Pa., Albert Schmid, Allegheny, Pa., and Bernard Hartley, Pittsburg. Pa.

The invention relates more especially to the construction of the armature. There are fourteen claims, the ninth being: "An armature for electric machines, composed of thin sheets of soft iron and thin sheets of paper or other electrically-insulating material pasted against one face of each sheet of metal."

374,860, (1), 374,861, (2). Apparatus for Measuring Electric Currents. Hermann Aron, Berlin, Germany.

These inventions are based upon the influence of the electric current upon the motion of clock work. Case (1) is secured by ten claims and case (2) by eight claims.

374,862. Electric Battery. John A. Barrett, Brooklyn, N. Y.

374,863. Galvanic Battery, John A. Barrett, New York, N. Y.

374,871. Electric Motor, William Hochhausen, New York, N. Y.

The invention consists in the combination with the electric motor, of an automatic variable resistance, arranged in a branch of the main circuit and responding to changes in the speed of the motor, so that with an increase of speed the amount of resistance in the branch will be varied to cause less current to flow, which, on the other hand, if the speed be decreased the resistance will effect a division of current such as to cause more current to flow into the motor.

374,872. Apparatus for Reversing and Controlling Electric Motors and Other Translating Devices, William Hochhausen, Brooklyn, N. Y.

There are five claims the first being as follows: "The combination, with an electric motor and two artificial resistances connected in series, of means for completing a branch circuit around either resistance at pleasure, and a portion of branch circuit common to both containing an electric motor or other translating device.

374,883. Electro-Mechanical Movement, Henry Van Hoevenbergh, New York, N. Y.

374,907. Multiple Switch Board Test Circuit, Charles E. Scribner. Chicago, Ill.

Instead of connecting the test wire with the line out on inserting a plug in a spring-jack, switch the cut-off portion of the line is connected with the test wire. The test is thus made through the cut-off portion of the line to the central office ground.

374,910. Regulation of Electro Motors, William Stanley, Jr., Englewood, N. J.

The invention is designed to prevent variation of speed under increase or diminution of load. A shunt of fine wire across the terminals of the motor is wound around the full magnet cores. In this shunt is included resistance and an electro-magnet for controlling the amount of said resistance in this shunt. The third claim is as follows:—"In an electric motor, the combination of a main or energizing circuit, a regulating magnet in said circuit, a shunt circuit to the motor, including a demagnetizing field-coil, a variable resistance, and an automatic switch mechanism operated by the regulating magnet to vary the amount of resistance in the demagnetizing coil inversely as the counter-electromotive force and speed of the motor, to the end of maintaining a constant determined speed thereof substantially as set forth."

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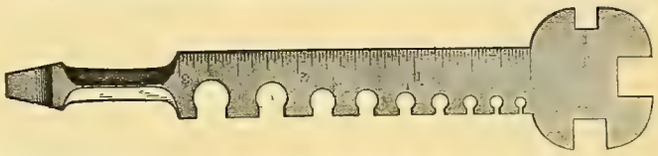

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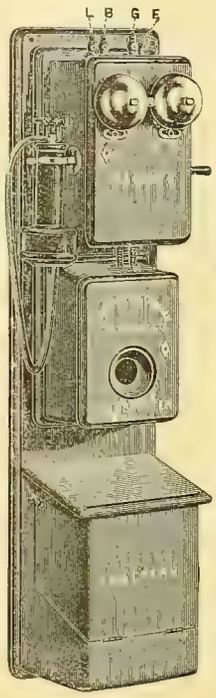

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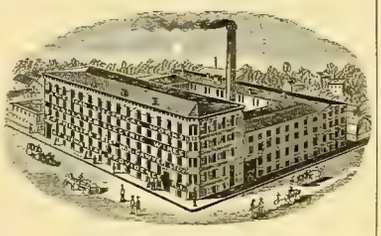

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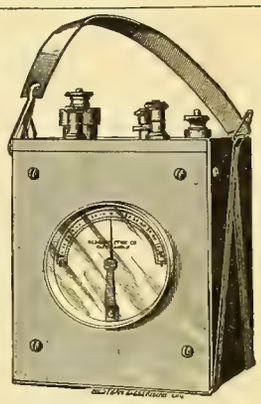

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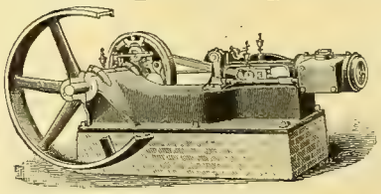

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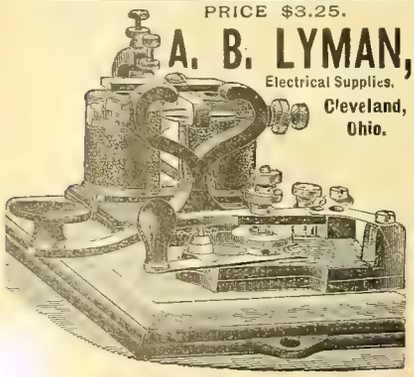

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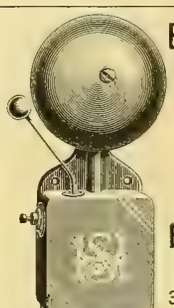

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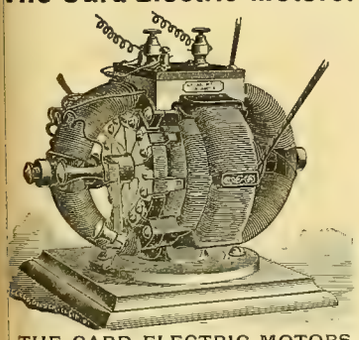

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Successors to THE BOULTON, CLEVELAND & CRYSTAL CARBON COMPANIES,

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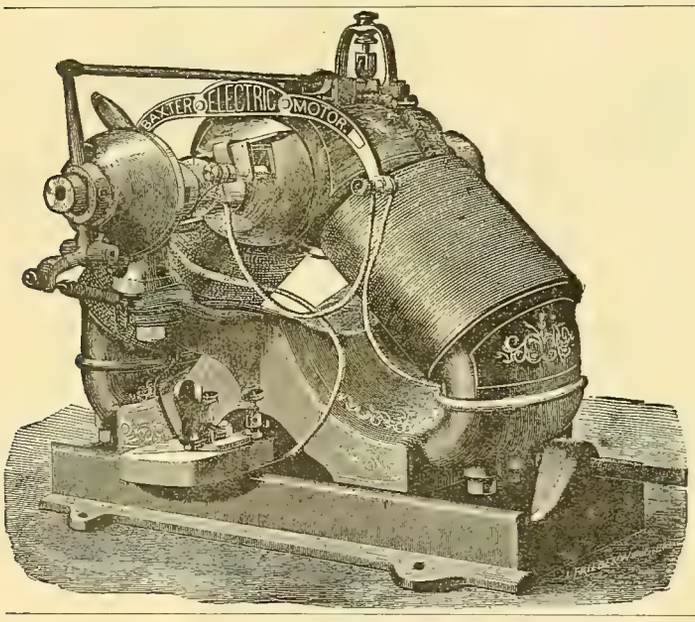

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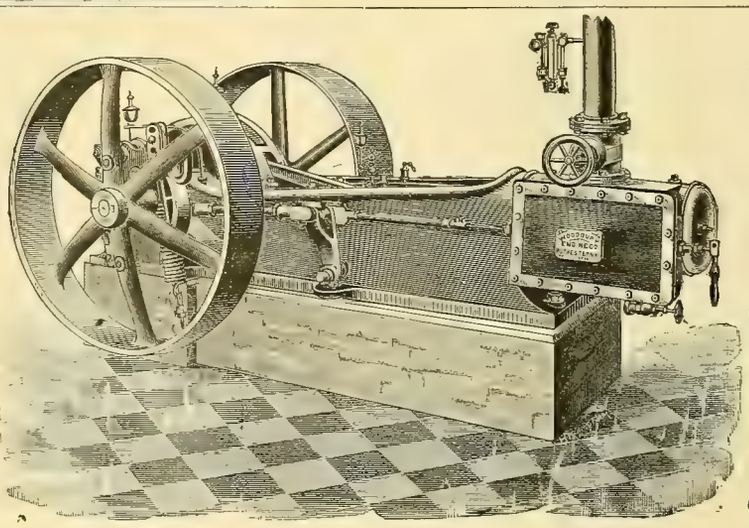

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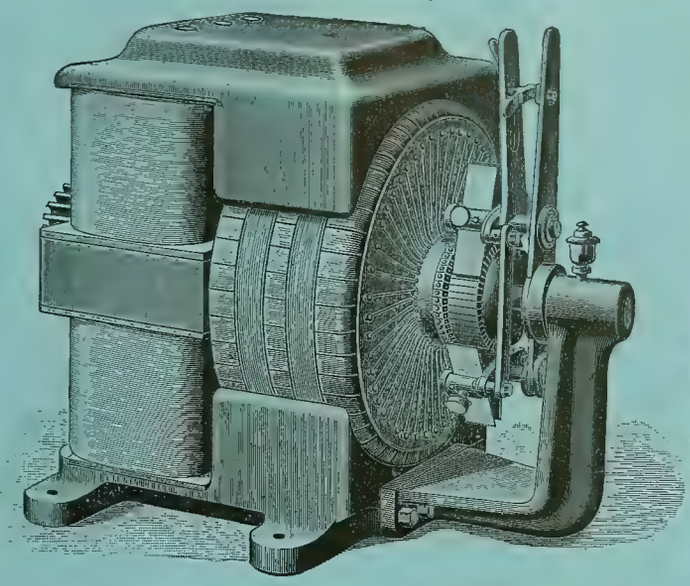
Our Arc Electric Light unequalled. The only perfect Double Lamp. Thousands in use. Guaranteed equal to any in every respect.



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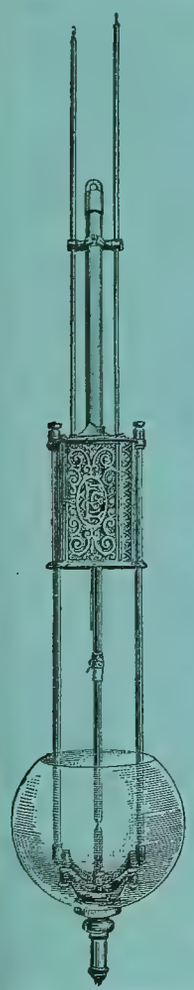

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By reason of its new Automatic Regulator that does not depend on merely shifting the brushes, but cuts out a portion of the field magnets as each light is turned off, saving the power in proportion to number of lights burning down to one light.

Dynamo is the simplest of all makes and requires no attention except to keep it clean. The lamps are ornamental, can be used in connection with any system from seven to fifteen amperes without change of magnets.

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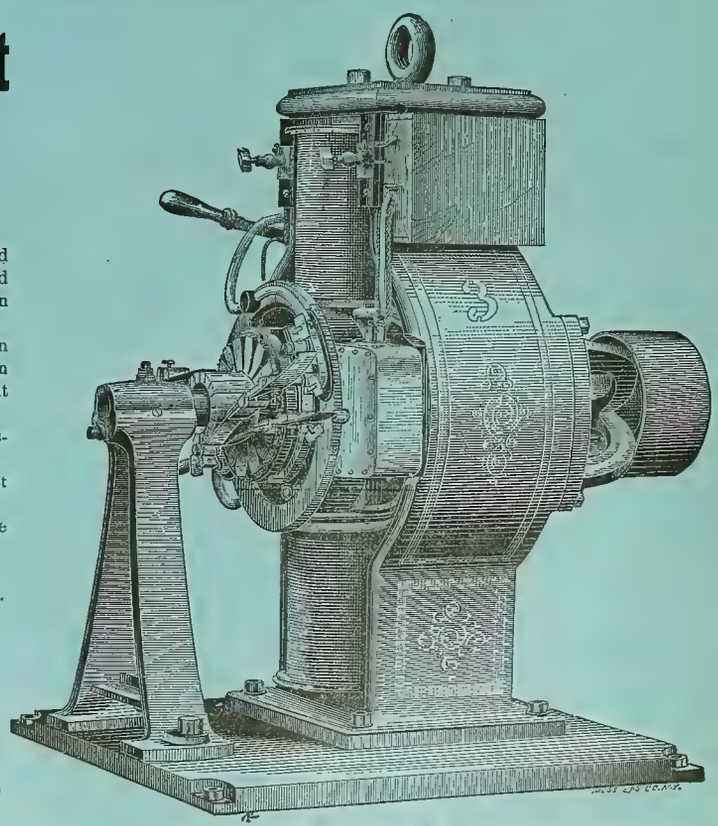

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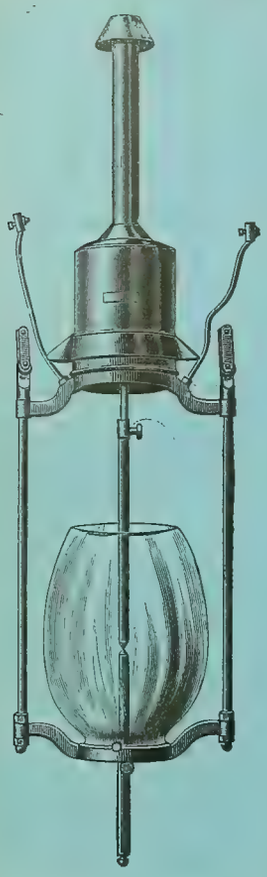

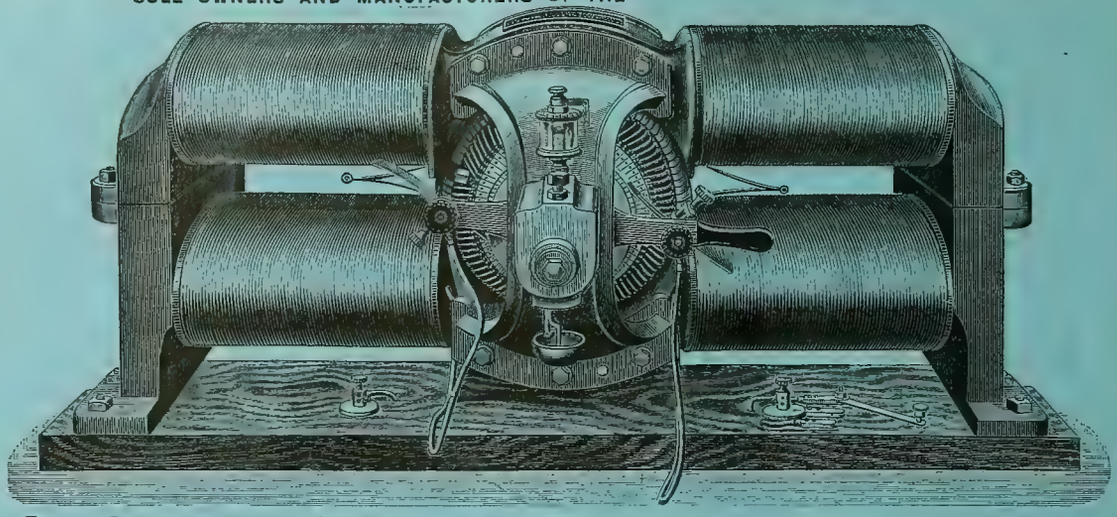

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The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

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At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

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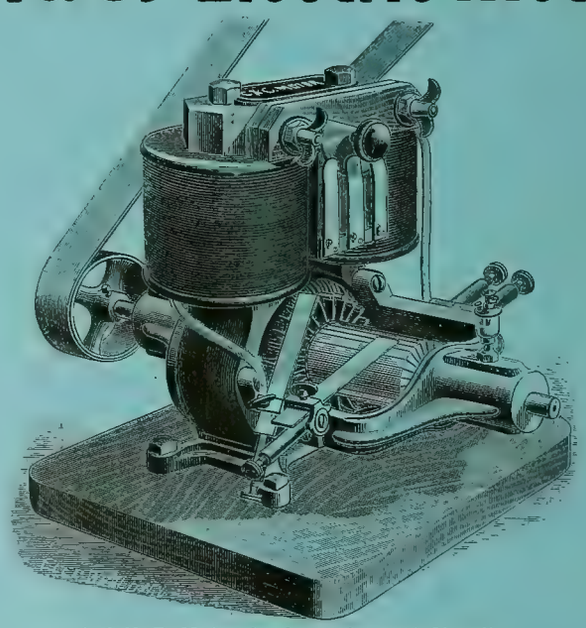

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Western Electrician

EVERY SATURDAY.

Vol. I. CHICAGO, DECEMBER 31, 1887. No. 27

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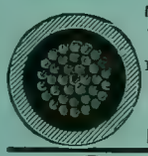

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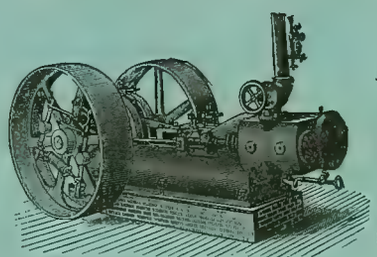

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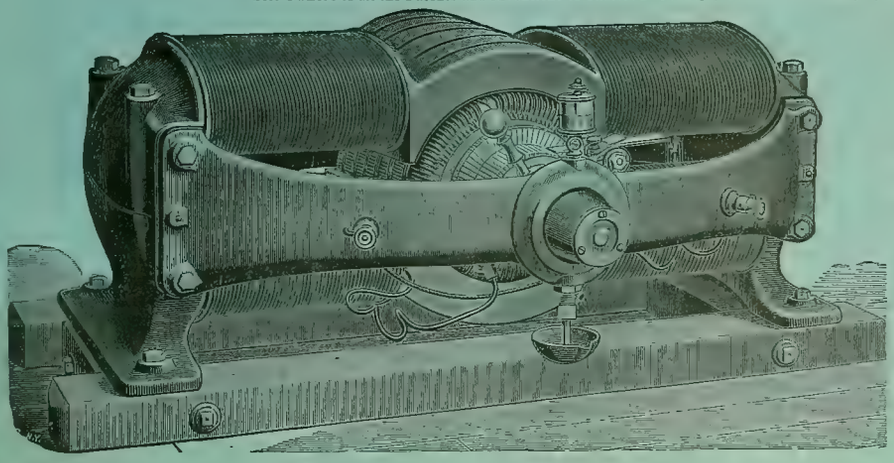

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In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

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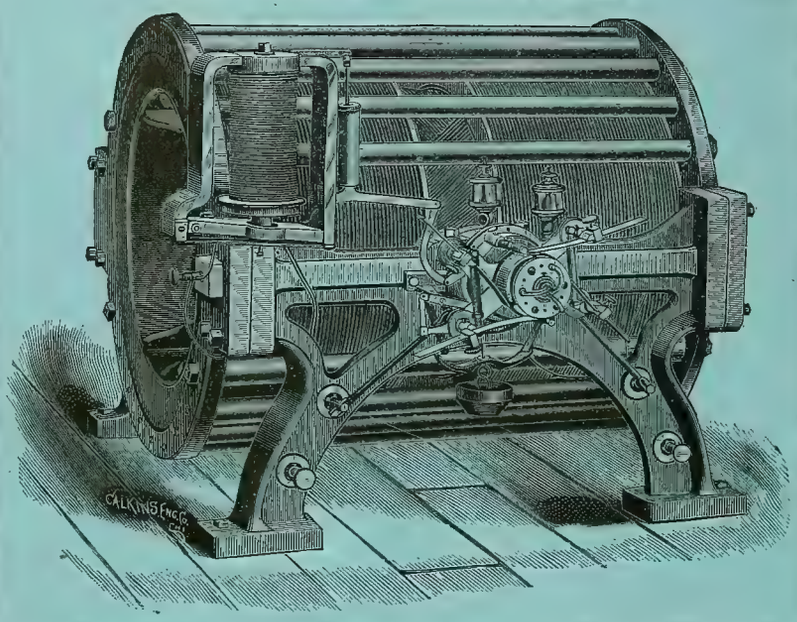
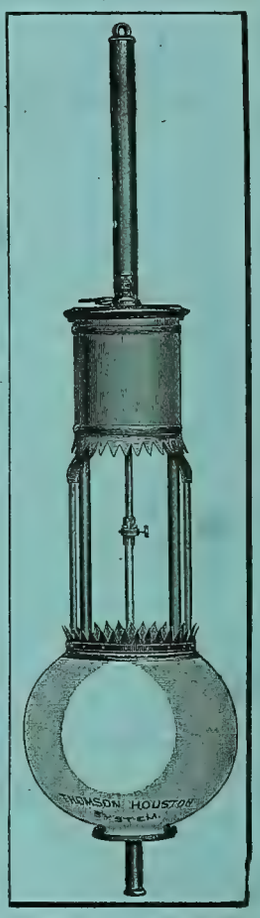


The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.



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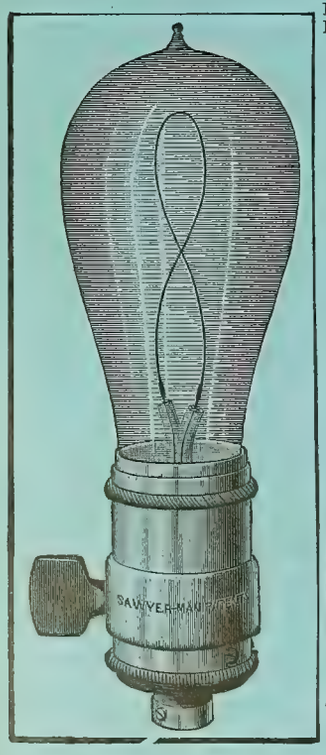
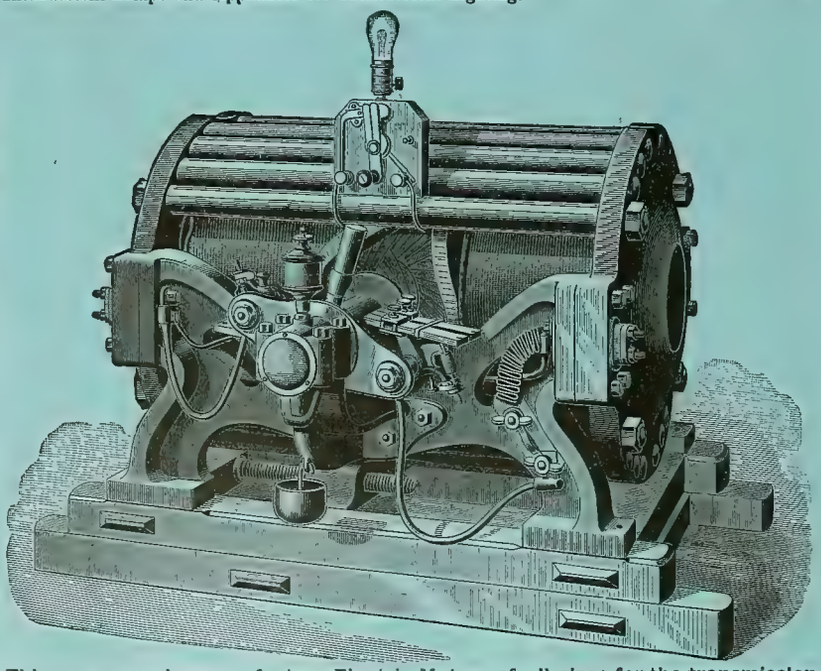
These dynamos are automatic in their regulation and will maintain a uniform ight, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





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OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

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IN

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12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

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Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,

LAMBERT HAYS,
Proprietor People's Theatre.

Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO., 185 DEARBORN ST., CHICAGO.

U. S. OLD LAMP

IN GRAND OPERA HOUSE, MINNEAPOLIS.

WHAT THE MANAGER, WHO DON'T GUESS AT IT, SAYS FOR IT.

He says, after having Careful Indications of Engines and Practical Electrical Measurements made, that

348 Edison 16 Candle Lamps require 54 Indicated Horse Power.
610 U. S. 16 Candle Lamps require 53 Indicated Horse Power.

He also says that, after having purchased and used a U. S. plant for Opera House, they purchased for the Syndicate Block an Edison plant because it was offered at a much less price (nearly one-half) than that of the U. S., and because of the Astonishing Guarantee made by the Edison Co. After testing and ascertaining the facts,

THE EDISON PLANT WAS REJECTED AND PUT OUT

and U. S. PLANT PUT IN ITS PLACE, the satisfactory working of which may be understood from a perusal of T. F. Conklin's autograph letter heretofore published in several issues of this Journal. Mr. Conklin desires to say that any statements of Edison representatives to the effect that the reason of such rejection of Edison plant was because some one or more of the Syndicate Co. were stockholders in the U. S. Co. is without any foundation in fact, as not one of them has, and never had a dollar's interest in the U. S. Co. beyond the purchase of a Fourteen Hundred Light Incandescent Plant for their Syndicate Block and Opera House.

U. S. 610 LAMPS REQUIRING 53 H. P.=$11\frac{50}{100}$ per H. P.
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Electric Light Carbons

Adapted to all Systems.

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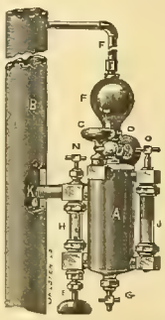

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Being SIMPLE in OPERATION and ALWAYS RELIABLE.

A Lubricator sent on 30 days' trial to responsible parties.

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EDISON'S OPINION.

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I have been carrying one of your watches, and going around Dynamos and other Electrical Appliances, where I have never been able to carry a watch without ruining it, and it has proved an excellent time-keeper. I consider Paillard's Balance a most wonderful and valuable invention, not only for workers around Dynamos, but wherever accuracy of time is required.

Very truly,

Orange, N. J., Dec. 7th, 1887. *T. A. EDISON.*

For Full Information about the Watches referred to in the above Testimonial, address:

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(LIMITED.)

177 & 179 Broadway, New York.

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MANCHESTER, CONN.

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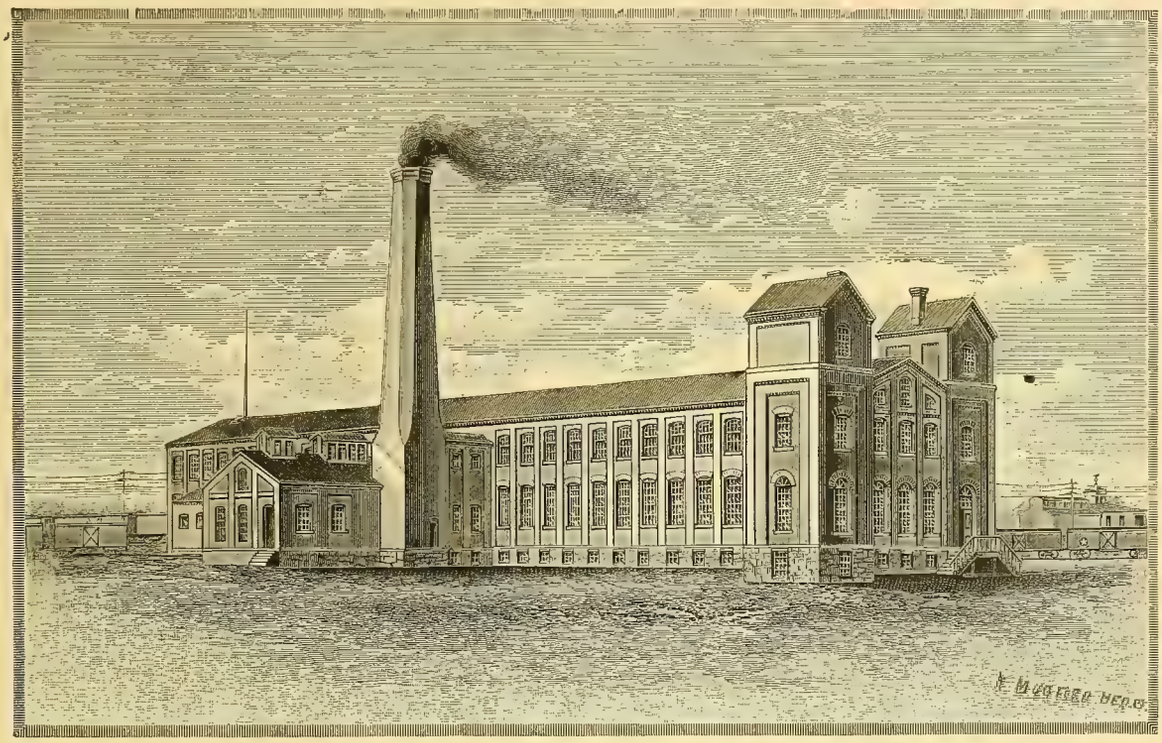

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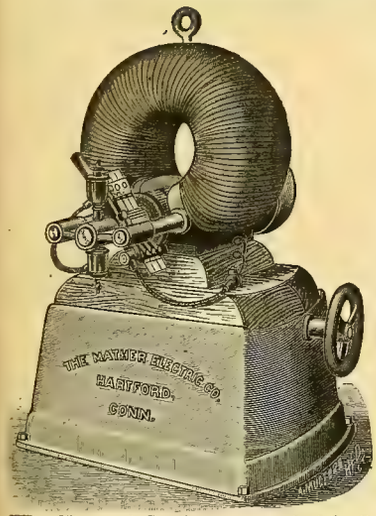
required for physical research, all the coils will be made from one piece of wire, to insure a uniform temperature coefficient. Galvanometers are made of high and low resistance, aperiodic and astatic, or not, as required. Tangent Galvanometers of any capacity will be made to order. Ammeters, Voltmeters and Resistance Coils will be calibrated, and constants furnished.

The Mather System for Incandescent Lighting.



The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and

DO NOT BLACKEN IN USE.

Our Dynamo is very simple in construction, runs without spark at the commutators and can be operated by any one accustomed to the care of engines or machinery. The system has no equal for mills, machine shops, or other places requiring isolated plants. We shall be pleased to furnish estimates for complete installations, with or without motive power, and will send one of our experts to examine the premises, if necessary.

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Western Electrician.

EVERY SATURDAY.

Vol. 1. CHICAGO, DECEMBER 31, 1887. No. 27

The Wallace Electric Cloth Lining.

This lining is for protecting places where valuables are stored, as safes, bureaus or wardrobes, and banks, stores, offices and residences, against burglars who understand the nature of electric appliances, and also against damage by fire or water. It is so constructed and applied that upon the least disturbance an alarm will be given at a central station.

Fig. 1 shows the construction, which consists in copper wires, *a, a, a,* interwoven in the fabric at distances of one to two inches, as may be desired. The cloth is pasted on the surface where protection is required, with the wires all running in the same direction. Alternate wires are then soldered together by their projecting ends, left stripped for this purpose, so as to form a continuous circuit through the cloth, as shown in Fig. 2. Thin paper is then pasted over the cloth, and over this is pasted another layer of cloth, with the wires crossing those of the first layer at any convenient angle, and the ends of these wires are soldered together in a similar manner. The construction is shown in section by Fig. 3; *C* representing the first layer of cloth, with the wire *a, a,* in the center between the threads, shown by the dots above and below it; *D* shows the second layer of cloth, the ends of the wires being shown at a^2 a^2 a^2 and *B* shows the intervening paper. Fig. 2 shows how the connections are made. At *e*, upper left hand corner, the wires of the two layers of cloth are soldered together so as to form one continuous circuit, and a resistance, *f*, introduced; *a' a' a'* showing the wires in the under layer, and *c c c* that in the upper layer.

At the lower right hand corner is shown a battery, connected with the circuit in the lining by the wire *g*; a Wallace balance relay being placed in the connection as shown, and at the lower left hand corner is shown a ground connection *c'*. This covers the entire space to be protected with a net work of wires in continuous circuit.

The resistances of coil *f* and of the balance relay, are carefully adjusted, so as to be exactly the same to a fraction of an ohm. If a connection is made between crossing wires, by burglarious tampering, or by fire or water, the resistance coil is thereby cut out, or short circuited, and the adjustment between it and the balance relay being thus disturbed, an alarm is instantly rung at the central station.

Fig. 4 shows how the lining may be used to indicate a leakage of water. Here only a single thickness is used; the alternate ends *m m* are connected with wire *p*, and the intervening alternate ends *m' m'* with wire *q*; and *p* and *q* are connected with battery *s* and alarm gong *t*. So long as the cloth remains dry the two sets of wires are insulated from each other, but if it becomes wet, even very slightly, the insulation is reduced, electric communication made between *m m* and *m' m'*, and an alarm given.

In the ordinary construction, the bare wire is woven into the cloth, but for special uses it is made highly insulated by a double cotton wrapping, waxed and paraffined.

The Electrical Protective Supply company, of Chicago, has been organized to push the sale of this lining.

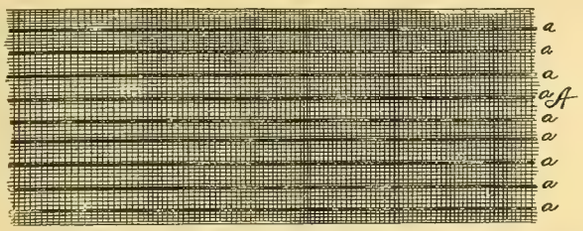


Fig. 1.—½ The Wallace Electric Cloth Lining.

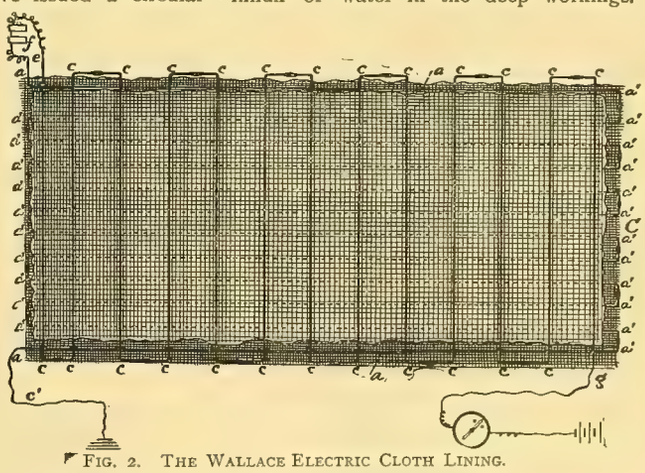


Fig. 2. The Wallace Electric Cloth Lining.

In Defense of the Carbon Suit.

E. I. Garfield, W. H. Boulton and George F. Porter, the executive committee appointed by representatives of the following companies: The National Carbon Co., the Globe Carbon Co., the Standard Carbon Co., of Cleveland, the Faraday Carbon Co., of Pittsburgh, Pa., the Thomson-Houston Carbon Co., and the Thomson-Houston Electric Co., of Boston Mass., to defend the suit brought against the Faraday Carbon company by the Brush Electric company to restrict them from manufacturing carbons, have issued a circular calling upon users of carbons for financial assistance in the defense.

The circular in part reads: "You can not fail to recognize the fact that, if the said Brush company are successful in their suit against the Faraday company, it will place the Brush company in such position as to dictate and control the price of copper plated carbons, placing them as the sole producer thereof; inasmuch as the Brush company in their recent connection with the carbon pool insisted upon a minimum price of $20.00 and $25.00 per 1000 for $\frac{7}{16}$ and ½x12 inch carbons respectively, it is reasonable to suppose that if they are successful in this suit, they would at once advance the price to at least the above figures, and in addition each electric lighting company would be liable to suit and damages for all carbons used by it during the years that have elapsed, since the granting of the patent on which said is suit brought. After consultation with legal talent who fully understand the validity of such claims, there is every reason to believe that the matter can be successfully defended."

The Haymarket theatre, Chicago, was opened last Saturday evening. It is brilliantly and thoroughly lighted by a United States plant.

Electric Pumping in Collieries.[1]

Before electricity is adopted by practical mining engineers, they must be convinced that it can compete economically with other modes of transmitting energy—modes which are well known and generally applied.

What percentage of indicated steam power applied to the generating electric machine is given off ultimately as available energy for mechanical work? How does it compare as to cost? Under what circumstances would its application be economical? If leading main questions such as these can be plainly and satisfactorily answered, practical men will not be long in arriving at a favorable opinion and acting upon it.

The first attempt at pumping mines by electricity was made four years ago, at Trafalgar colliery, England, doing the work of about 1½ horse power, and it has continued satisfactorily up to the present time. In another part of the same mine 2½ horse power, 800 yards from the surface has been in successful operation for the last eighteen months. These pumps have been used to remove accumulations of surface water from abandoned workings. More recently another pump has been put to deal with the main influx of water in the deep workings. The pump and motor are placed about 1,650 yards from the bottom of the shaft, and the water has to be forced to a vertical height of 300 feet from the pit bottom. The pump is a double 9-inch plunger, with vertical stroke, and makes 25 revolutions per minute. The motor—an Elwell-Parker 12-inch—has a maximum speed of 650 revolutions per minute, and an output of about 13,000 watts. The electric current is conveyed to it by a copper cable 2,000 yards long, inclosed in wooden boxes in the pit shaft, and supported on earthenware insulators along the side of the underground roads at intervals of about 10 yards. The return cable is an old iron pit rope of about four inches in circumference stapled to the road posts. The generator—an Elwell-Parker 12-inch, also—is placed on the surface near the shaft. Its maximum speed is about 950 revolutions per minute, and output 17,000 watts. The steam engine which runs it has a simple 16-inch cylinder with 12-inch stroke, and works with about 35 pounds steam pressure. It is an old worn affair, and runs at a serious loss. The steam is obtained from the colliery boilers near by. By means of a small battery, with connections between the engine house and pump, each

1. Abstract of paper read before the South Wales Institute of Engineers, Cardiff, by Frank Brain, November 24, 1887.

stroke of the pump is registered on a belt in the engine house. This is also used as a telephone line for communication between the engineer and man in charge of the pump. The two smaller pumps are locked up and require no attendance except an occasional visit, and the large one requires little more than oiling the machinery, adjusting the brushes and turning on the current.

The indicated horse power of the steam engine is 29.49, the actual horse power utilized in lifting water is 10.36, showing a loss of 65 per cent. or an actual utilization of 35 per cent. The loss is distributed as follows: Engine 22 per cent., generator 16 per cent., line 11 per cent., motor 10 per cent., pump 6 per cent.; total, 65 per cent.; 114 gallons per minute being the amount of water raised. The total cost of one week's working, 22 hours per day, at this rate, to lift the water 300 feet, was found to be £7 17s; equal to .02 of a penny per horse power, or 1.8 pence per 1,000 gallons of water raised.

During the past dry autumn the flow of water has been much below the average, so that the average pumping has been only about 64 gallons per minute, hence the proportion of power utilized has been only 32 per cent., making the cost per horse power .03 of a penny, and the cost per 1,000 gallons of water 3 pence.

When pumping is not required, the plant is utilized for ventilation. A small fan, placed 1,200 yards underground, and passing about 10,000 cubic feet of air per minute, is placed in a return air-way.

The cost of maintaining the present plant, as compared with the former method by steam and tubular boilers underground, shows an economy of about £470 per annum.

The plant commenced working without a single hitch, and has worked continuously since the end of May last with but one slight accident, or rather temporary loss of insulation, which was easily remedied by the substitution of a lead-covered cable excluding the moisture which occasioned the loss.

It was feared that interruptions would occur from damage to the cable by falls on the underground road; but in practice this difficulty has been found to be illusory, the iron rope being practically indestructible, while the damage to the copper cable, should any occur, can be quickly repaired.

The whole construction is so simple that the colliery mechanics can easily make any repairs required, and the services of an electric expert are not required.

One great advantage is the concentration of work under the personal supervision of the managers. With sufficient engine power any reasonable number of generators can be driven in one engine house on the surface, delivering power to various distant places underground. These dynamos would require but one man to attend them.

This plant can be put down economically and with great dispatch; no matter how intricate the route may be, a motor, one or two thousand yards distant, can be put to work in as many hours as it would require weeks to put in pipes for steam, compressed air or water, and at far less cost; the outlay for pipes, ditches, protection, etc., over a devious route, by the latter method being very great; and breaks are constantly occurring, entailing serious cost and delay for repairs. With a pump in the mine, and a steam engine a mile distant at the surface, it is practicable to have the whole plant in running order by the electric method in a week.

Comparative cost of different methods of haulage in mines, published in 1883 by Beringer, are as follows: Ten effective horse-power hours transmitted 5,465 yards, cost per effective horse-power per hour by electricity, 2.64 pence; by compressed air, 4.66 pence; by cables, 4.69 pence; by hydraulics, 5.29 pence. Steam power was used in each instance, and the results of the examination showed that for distances of about 1,000 yards cable haulage costs least, but for longer distances electricity maintains itself against all other systems.

Hence, for pumping, hauling, ventilating and coal cutting, and, we may add, for lighting, the electric method must take an important place in future colliery working.

Fig. 3.—The Wallace Electric Cloth Lining.

Nicholson & Waterman's New Engine Lathe.

The lower illustration shows a new engine lathe recently placed on the market by Nicholson & Waterman, of Providence, R. I. The tool is designed to do heavy or light work as occasion requires, and to wear indefinitely. The lathe is 16 inches by 8 feet long. Independent rod and friction feeds are employed. The steel lead screw has large, long bearings, and an improved adjustable take up, and is provided with an open and shut nut, operated by a lever. The spindles are made of high grade hammered steel. The head stock spindle runs in composition boxes and has a $1\frac{1}{16}$ in. hole through its entire length. The front bearing is $4\frac{1}{2}$ inches long by $2\frac{1}{2}$ inches diameter, the rear bearing being $3\frac{1}{2} \times 1\frac{3}{4}$ diameter; both

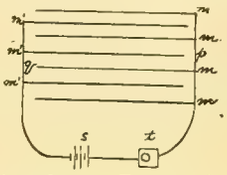
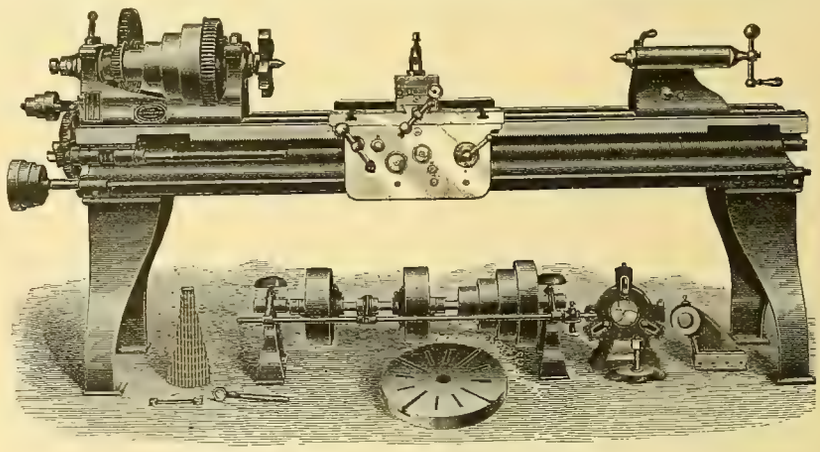


Fig. 4.—The Wallace Electric Cloth Lining.

of these bearings are carefully ground and scraped to insure the finest possible wearing fit. The cone has four grades, the largest being 11 inches diameter with $1\frac{1}{8}$ inches drop and $2\frac{5}{8}$ inches face. This length of bed will turn 4 feet 9 inches in length by 11 inches diameter over carriage. All sliding surfaces are fitted by scraping. The foot stock spindle is 13 inches long, 2 inches diameter and has a bearing its full length. The carriage is gibbed front and back, and has long, wide bearings with convenient means of adjustment. It also has a binder for holding carriage while squaring up. The apron gearing is simple and accessible and is provided with power cross feed. Ample backing and bracing has been obtained by increased metal at all points of strain. Gears are furnished for cutting all pitches from 2 to 24. By means of an additional stud, a thread can be cut of 48 pitch. Every lathe is provided with the friction counter-shaft shown, the operation of which is by wrapping contact, securing firm hold and easy operation.

The lathe will be found a most convenient tool for the varied work of the machine shops of electric light apparatus and motor manufacturers.



Nicholson & Waterman's New Engine Lathe.

It is stated that the New York, Lake Erie & Western railroad has decided to adopt an electric train signal in place of the bell rope.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number xxiii.

Ayrton & Perry's Ammeter.—This well known instrument, shown by Fig. 55, depends, like the instruments described in the preceding number, on electro-magnetism acting in opposition to permanent magnetism. A soft iron needle having a free horizontal movement, is pivoted between the poles of a powerful horseshoe steel magnet which in part forms the case, as shown. A pointer, attached to the needle, indicates the readings on a scale, graduated in degrees from 0° at the center to 45° at the right and left. The needle is inclosed in a helix of ten coils of heavy copper wire, with which are connected with ten springs, shown near the scale, which press against a roller, within which connections are so arranged that by a quarter turn all the coils can be connected in series, the current passing ten times round the needle, or connected in parallel, the current passing round it but once, and the resistance being reduced to one tenth of the series resistance. By this arrangement the instrument can be used to measure either strong or weak currents. When no current is passing, the needle is brought to rest between the poles by magnetic attraction, the pointer indicating 0°; when the current passes, the needle, being magnetized, is deflected, the pointer moving to the right or left according to the direction of the current. For weak currents the series connection is used, represented by the terminals S P and S, and for strong currents the parallel connection, represented by S P and P; a weak current being thus made capable of producing as great deflection as a strong one.

The instrument is so adjusted that with the series connection a degree equals one-fifth of an an ampere, and with the parallel connection, two amperes. Hence ten degrees deflection with the series connection shows a current strength of two amperes, ($C = \frac{1}{5} \times 10 = 2$ amperes), while ten degrees with the parallel connection shows a current strength of twenty amperes ($C = 2 \times 10 = 20$ amperes).

By means of a plug, shown at the left in front, a fine wire of one ohm resistance can be introduced into the series connection as a test of accuracy when adjusting. To maintain constancy in the magnet, when not in use, the poles are connected by an armature, shown in front; this must be removed before using the instrument, and replaced afterwards. A battery is used in adjusting, or calibrating, as it is termed. The instrument is absolutely dead beat, and responds to the smallest variation of current.

Ayrton & Perry's Voltmeter.—This instrument is similar in appearance and construction to the ammeter, but has high resistance; the usual resistance in series being 400 ohms, and in parallel, four ohms; but higher resistances can also be used in the construction. A deflection of one degree is made to indicate one volt and also five volts; and since the range of deflection is from 0° to 45° the range of measurement in volts is from one to 225.

Ayrton & Perry's Spring Voltmeters and Ammeters.—The unreliability of measuring instruments, constructed with permanent

magnets and consequently requiring frequent recalibration, and the demand for instruments with direct readings to avoid troublesome calculations, has led to improved methods of construction, of which the spring voltmeters and ammeters of Ayrton & Perry are a result. Fig. 56 represents the ammeter, the voltmeter being of similar construction. In the center of a vertical coil, of low resistance for the ammeter and high resistance for the voltmeter, is suspended a

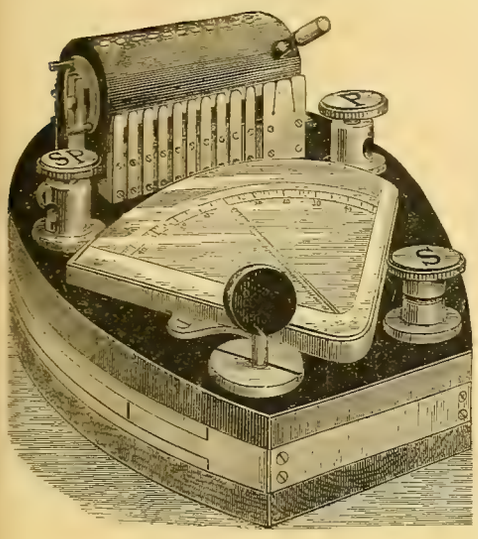


Fig. 55.

small brass tube, which terminates below in a little soft iron armature, and incloses a long spiral spring of phosphor-bronze. This spring is attached to the tube at the bottom, and attached above to a milled head, fixed in the glass cover, so that the tube has a free vertical movement, and also a horizontal movement, limited by the torsion of the spring. To the top of the tube is attached a light aluminium pointer which moves over a scale, graduated in volts or amperes according to the nature of the instrument.

When no current is passing, the weight of the tube and attached armature tends to uncoil the spring, giving the tube a horizontal movement, and bringing the pointer to rest over zero at the left of the scale; but when the current passes, the armature is attracted upwards into the coil, and the torsion of the spring turns the tube and moves

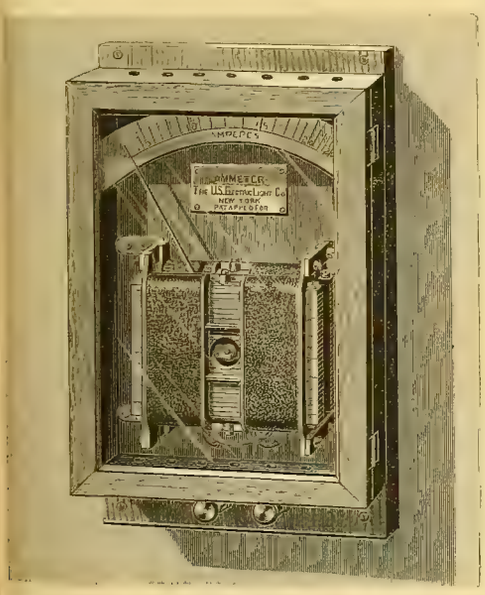


Fig. 57.

the pointer from left to right. And as the upward movement of the armature is in direct proportion to the strength of the current, the instrument can be so calibrated as to give direct readings in volts or amperes.

The tube can be turned by the milled head so as to bring the pointer to any position required for adjustment. A reflected image of the pointer in a mirror placed under it, enables the observer to determine accurately its position on the scale. A little magnetic needle, shown at the front corner of the base indicates the direction of the current. The instrument is inclosed in a case ventilated above and below, as shown, to prevent the accumulation of heat as the current passes through the coil, which would expand the spiral spring and produce inaccuracy. The usual binding posts connected with the terminals of the coil are shown at the right and left; the left post being marked A to distinguish them in use.

United States Electric Lighting Co's Ammeter. — This instrument, represented by Fig. 57, is constructed on the principle of electro-magnetism opposing gravity. A magnetic field is produced by two electro-magnets with laminated soft iron cores, placed as shown, magnetically insulated from each other, and wound with coils of low resistance. At the center between these magnets is placed a soft iron armature, lightly poised on a horizontal axis, the end of which is seen through a circular opening. This armature is shaped like two Ws joined together by their smaller ends.

It is slotted at the broad ends to correct the effects of residual magnetism, and has a small brass weight attached to the lower left hand corner. A pointer attached to its axis indicates the current strength on a scale above, graduated in amperes from 0 to 25, 50, or more as required, and subdivided to tenths.

The instrument is placed directly in the main circuit by connection with the binding posts, shown at the base. When no current is passing, the little weight attached to the armature brings the pointer to rest at zero on the left, as shown, the longer axis of the armature being then in a diagonal position between the lower right and upper left hand corner of the instrument; but when the current passes, the armature tends to assume a vertical position in obedience to magnetic force, and this force being in proportion to the strength of the current, the indications on the scale, as the pointer moves from left to right, shows the current strength in amperes.

As the force of gravity is always known and constant, the advantages of such an instrument over one dependent on a variable force like that of a steel magnet, whose magnetism is continually weakening, and requires frequent renewal to insure approximate constancy, must be apparent.

A potential indicator, similar in appearance, and constructed on the same principles, but having coils of high resistance, and a scale indicating potential variation in volts, is also used in the same electric lighting system.

The Western Electric Co.'s Ammeter.— This instrument, shown by Fig. 58, depends on the principle of construction just referred to,— electro-magnetism opposing gravity. An electro-magnet having for its core a cylinder of soft iron, inclosed in a coil of low resistance, is placed vertically on the base. The upper end of the core terminates in a pole piece having an ascending curve, and near the lower end of this curve is a **T**-shaped armature of soft iron, poised on a horizontal axis, and connected with a pointer which moves from left to right over the scale above. When no current is passing, this armature hangs vertically, and the pointer indicates zero on the scale. But when the current passes, the armature is attracted and moves upward from right to left in the arc of a circle, the distance between this curve and that of the pole piece being so adjusted by the shape of the latter curve as to compensate the variation of magnetic force and keep it practically constant on the curve in which the armature moves; the curve of the pole piece approaching that of the armature as the armature rises, the magnetic force varying inversely as the square of the distance between the curves. To the right of the armature is a soft iron post connected magnetically with the magnet core, and known as the compensating pole, its top curving towards the main pole, so that the distance between the two may be adjusted by turning this post so as to regulate the magnetism of the field when adjusting the instrument.

The binding posts below show the connections with the circuit, and the scale is graduated in amperes and fifths from 0 to 20 and upwards.

The Wood Dynamo.

In the article on "Elements of Electric Lighting" published in No. 20 of the Western Electrician, page 235, the Wood dynamo was spoken of as "a reconstructed form of the Fuller dynamo." The appended communication gives the facts in full:

New York, Dec. 17.—All the Fuller apparatus was made between the years 1876 and 1879, Mr. Fuller died during the fall of 1879 and the dynamo in question was not designed until the year 1880.

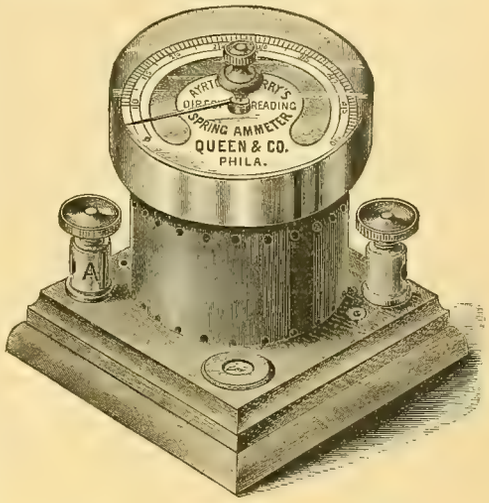


Fig. 56.

All of Fuller's apparatus was constructed on a plan similar to that of the Lontin dynamo; there were about 80 of the Fuller machines built. They weighed about 590 pounds each, taking 5½ horse power, and produced a current in the external circuit of but 50 volts and 10 to 11 amperes. I designed my first machine in May 1879. This was of the multipolar pattern; it weighed but 86 pounds, took one and two-tenths horse power and produced a current of 40 volts and 8 amperes. This dynamo replaced the Fuller machines which were broken up when the present form of apparatus was designed. This form has been improved from time to time until we believe it fully equal, if not superior to any dynamo ever constructed for arc lighting. James J. Wood, Electrician.

Electric Lighting in Italy.

The Bellini theater in Palermo has recently been fitted with an electric light installation, three hundred Edison glow lamps and five Thomson-Houston arc lamps being employed. The glow lamps are fed by Zipernowsky trans-

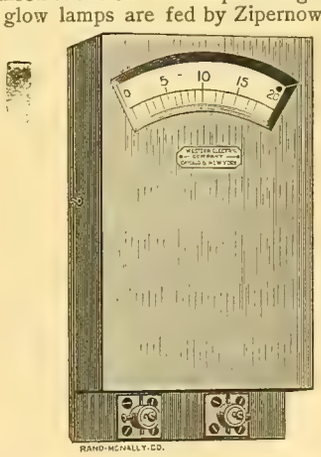


Fig. 58.

formers, the current being supplied from a generating station some distance off by Ganz alternate current machines. The arc lights are fed from a Thomson-Houston dynamo, motive power being supplied by an Armington & Sims engine and a Babcock & Wilcox boiler. Two reserve arc lamps are switched on in case the other portion of the electrical plant should fail, and the glow lamps be extinguished, the object being to provide against a panic.—Three distinct electric light installations have been started in Venice. One of these has been fitted up on the seaside promenade, Lido, a small island in front of the harbor, by the Edison company of Milan, and

consists of over twenty Siemens arc lamps, and two hundred incandescent lamps The arc lamps take a current of from 8 to 10 amperes. There are two 30-unit Edison dynamos, and motive power is provided by an engine made by Messrs. Ruston, Proctor, & Co., of Lincoln. The second installation is in the public gardens, and has been carried out by a local electrician on behalf of the Electrotechnische-Fabrik, Canstadt, Germany. There are twenty-eight arc lamps taking 6 amperes each, and two hundred glow lamps, current being supplied by two 12-unit dynamos made by the above firm. The engine is by Messrs. Sulzer Brothers, of Winterthur.

The third installation is on the island known under the name Isola della Giudeca, and consists of 160 incandescent lamps of Siemens make, distributed throughout the streets. These lamps are coming into favor in Italy. In this installation current is supplied by two 9-unit dynamos made by Messrs Alioth & Co., of Basle, the successors to the firm of Bürgin, Alioth & Co. The approximate cost of the three installations is as follows: Lido, £1,600; public gardens, £2,200; Giudeca, £750.—*Industries.*

Storage Batteries and Electrical Distribution.

By Rankin Kennedy.

Distribution systems have now arrived at sufficient perfection for extensive testing, and the leading systems have been already tried widely enough to enable electrical engineers to draw conclusions as to the practical values of the various methods of distribution.

The direct supply at 100 volts on a three-wire system has been extensively applied. This system is the very acme of simplicity; but it can not be extended over wide areas at reasonable costs, and therefore commercially it is a failure.

In this system storage batteries may be used freely, both at the consumer's end and at the central station; but if the system does not pay in its simplest form it is not likely to pay, or even to be at all considered, as a distribution system. If storage batteries are introduced, the added cost and maintenance of the batteries would be prohibitive to the use of such a system.

The next system which may be considered as having passed through its practical trials is the high-pressure alternating current and transformer system. In this system storage batteries can not be used by the consumers, the consumer gets his supply from a transformer direct.

This want of storage at the consumer's end has been raised as an objection against the alternating system; but some of those who have had most experience in supplying by this system maintain that storage by the consumer is unnecessary and undesirable; first, on the ground of cost; and secondly, on the ground of attendance required by the battery, which if left to the consumer would be neglected, and if in the hands of the supply firm would entail cost of wages; in fact, this high-pressure alternating system may make the gas supply system its model. No consumer of gas thinks of storing gas on his premises; but it may be urged that a breakdown of the transformers may occur; such an occurrence is possible, but practically, all but impossible. Transformers are far less liable to break down than storage batteries; in fact, a consumer would be less likely to lose his lighting from a breakdown of a transformer than he is to lose his lighting from a breakdown of his gas meter.

Of course, transformers can be made, and have been made, that will break down; but no one who has made them will deny that they can be made so that a breakdown is as nearly impossible as the breakdown of anything made by human skill.

Although it would thus appear that storage by the consumers is of no account in any system, gas or electric, it is of equal and great importance to both at the generating station. Gas distribution would be impossible if storage at the central station could not be accomplished, and every electrician agrees upon the necessity of storage at the electrical central station. Out of ten failures nine occur at the central station; with its complex arrangements it is the weak spot in all systems. Boilers, pumps, valves, engines, belts, pulleys, bearings, dynamos, and other appliances are here continually wearing and requiring repair; and sometimes a failure of some very small and apparently trifling part of all this organization causes a complete stoppage of the whole.

Upon these considerations it is imperative that storage should be taken into account at every central station; the whole question is one of cost.

Of course, the chances of the failure of the storage battery should be taken into account; they should be about as reliable as the gasworks gas-holder before adopting them largely for central station work; only on the ground of perfect reliability, and on that alone, can their use be advocated at all.

Taking it for granted that storage is commercially permissible and practically perfect, we can employ it at an alternating current station; thus we can easily store a large current at low pressure, and convert it into a small alternating current at high pressure, and distribute it to the mains in this form.

A combined motor and alternating generator is used for this purpose; the motor armature is driven by the low pressure large current, and being on the same shaft as the generator armature, generates an alternating current of any given pressure to pass into the mains. Such an arrangement provides against any failure occurring in the mechanical arrangements at the central station, and that is about all that is required.

Lately the high pressure continuous current system has been advocated again; nothing has been done with it on a practical scale of distribution, although the transformers have received some attention.

In this system the consumers may have storage from the transformers, if that is of any advantage. Against this must be placed the attendance required by both transformers and storage batteries, both being subject to wear and tear.

At the central station, if storage batteries are to be used direct to the mains, then a vast series of them are required for, say 2,000 volts pressure, about 1,100 batteries would be required in series. Fewer storage batteries could be used by employing a combined motor and generator to raise the pressure from 200 to 2,000 volts. In that case, 110 storage batteries could be used.

Such an arrangement has no advantage over the same for the alternating central station, but would have some difficulties in collecting the 2,000 volt current at the generator, which are not present in the alternating generator; and then there are also difficulties in the commutating of motors on the consumers' premises working at 2,000 volts.

It would appear that if any one of the storage battery makers would bring out a cheap enough battery for central station work, they would no doubt receive a fair trial on a large scale with both alternating and continuous current transformers. As the matter stands just now the adoption of storage raises the cost to such a degree, that no central station, except a few in very favorable situations, could obtain customers at paying rates.

In some wealthy quarters in London a rate of 8d. per unit may be easily got; at such a rate a central station employing storage might be run without any loss. But a really popular rate to compel the ready adoption of electric lighting anywhere and everywhere must compare with gas rates. In fact, in few towns of any size would a rate for electricity of more than 4d. per unit be acceptable. The only system known to the author, really able to work at or very near this low rate and realize a profit, is the alternating system without storage.

There is another item of cost in electric lighting, which proves a heavy obstacle to progress in central station electric lighting, and that is the monopoly in lamps; we can get along somehow without storage batteries until they get cheaper, but good or bad, cheap or dear, we must have lamps; the restrictions on the manufacture of lamps in Great Britain make electric lighting progress exceedingly difficult.

In fact, the two great questions for the consideration of electric engineers with a view to future progress are: First how to obtain cheap storage; and second, how to obtain lamps at 1s. each with a life of 1,000 hours.

These two problems solved, electrical engineers in this country would find more work to be done than they could undertake without largely increasing their business.

Cheap storage may be obtained, but the lamp appears a hopeless case until it is free to all manufacturers to make and sell in competition in the market.—*London Electrical Review.*

Practical Telephony.

By Thos. D. Lockwood.

Part III.

The Calling Generator.—I described in part II the signal bell chiefly used in telephony. It is, of course, essential that persons using the telephone shall be able not only to receive a call but also to send one; and it is equally essential that they must have something to do it with.

In the Morse system of telegraphy, this is done by placing a finger key in the circuit by which the circuit can be closed and broken. And if

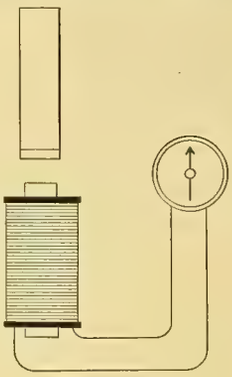
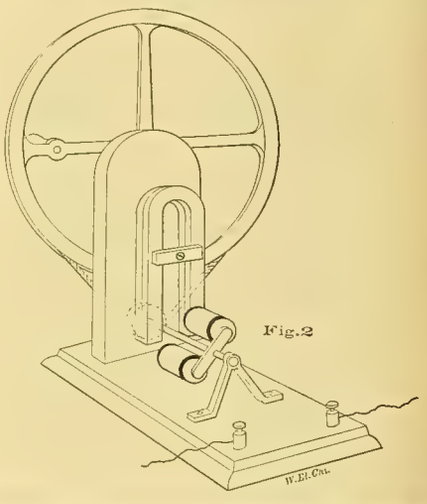


Fig. 1.

simple electric bells are used as the call receiving instrument, ordinary keys can in this case also be used.

But as the polarized bell is for telephone exchange work, now universally used; and for private line work nearly so; and as in considering sub-station outfits a magneto machine is also nearly always employed to develop and transmit the calling currents of electricity, it seems best to give our exclusive attention to that organization here.

In practice then, to operate our polarized bell, which it will be remembered I have stated is responsive to electrical currents of continually changing direction, not only do we place it in circuit with a magneto electric machine, but we place the two instrumentalities both in the same box. This is only for convenience. There is no



electrical or mechanical reason why they should be so placed.

Everyone will remember that when he wants to call some one by means of the telephone apparatus, he vigorously turns a handle or crank on the side or front of the box; and while it is something involving the exercise of faith to assume that this act of turning the crank does indeed cause a distant bell to ring, or a distant annunciator shutter to drop, it is not an unreasonable exercise, because the bell at the home

station — the station where the crank is turned is both seen and heard to ring; and it is fair logic that if turning the handle makes a bell ring at home, it can also have the same effect at a distant point connected with the same wire. And this is indeed just what takes place. The turning of the handle generates currents of electricity which pass over the circuit of the line wire and through the magnetic coils of both the home and distant bell, ringing both. Now I will explain how this is accomplished. There are only two ordinary ways in which the turning of a handle can develope electricity; namely, by means of friction or static induction, as in the case of the well-known

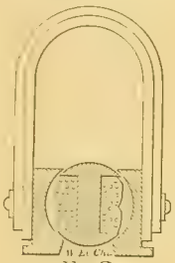


Fig. 3

frictional or Holtz machines; or by magneto electrical machines, as in the case of the medical machines where two handles are attached to an oblong box, and where shocks are given to a person holding the two handles, by the turning of a crank, or as in the case of the electric light dynamo. Which of these modes is used to generate the calling current? The popular name of the machine will tell us; we call the whole thing "a magneto bell." And sure enough a magneto machine it is; for the electro-static or induction machines would not generate a current in a circuit at all, or at least not one that could be used to ring a polarized bell; and yet I have known persons who ought to know better, quite frequently term this machine a "frictional machine." The principles employed are quite different.

Let us look at the drawing Fig. 1. You see a coil of wire, a bar magnet above it and pointing vertically down to it; and a galvanometer connected by two wires with the coil. The wire, is of course, insulated. As long as these instrumentalities are left alone, nothing occurs. But if you smartly bring the magnet closer to the coil, or allow it to fall into the coil the needle of the galvanometer will make a sudden deflection to one side or the other. It will not, however, stay there, and if the magnet is left in the coil and is kept still, the needle will come back to the zero position. Now let us sharply withdraw the magnet; the needle will then make a smart movement in the opposite direction, and again resume its zero position. Or, if we leave the magnet at rest, and move the coil to and from the magnet the same results will occur. Suppose now we let the magnet pass completely through the coil, what will happen? The needle will first

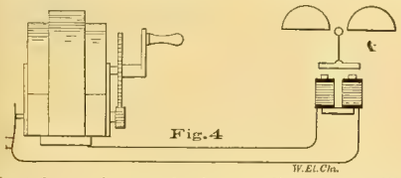


Fig. 4

deflect for an instant in the one direction; will immediately recover itself, and deflect in the other direct and will again repeat the first deflection. These experiments prove that by means of the magnet with respect to the wire coils electrical currents are generated in the latter; that the direction of the current depends upon the pole which moves toward the coil, and upon the direction in which the magnet moves; that it is necessary not only that the magnet and wire must be near one another, but also that there must be motion, before a current can be generated; and finally that it does not matter whether the magnet moves near the wire, or the wire near the magnet. This was discovered by Faraday over fifty years ago; and the fact can now be stated, that when a wire is moved near a magnet, or a magnet near a wire, a tendency to excite a current is developed in the wire and that a current *is* excited when the two ends of the wire are united, or when the wire forms part of a closed circuit.

This discovery it is, which enables us to construct the magneto generator. The first forms of the generator used in telephone bells, were like that shown in Fig. 2. A horse-shoe magnet was mounted vertically in a box, and a couple of coils of insulated wire mounted on a standard and arranged to be revolved by means of a crank on the outside of the box as at present. Both coils had cores of soft iron fixed within them, and the cores were united at the back by a heel-piece just like an electro-magnet.

On the principle which I have already described, when these coils are rotated in front of the two poles of the horse-shoe magnets, currents of continuously alternating direction are developed in them, and if the coils are so arranged as to be included in the circuit of a telephone line, the currents will traverse that circuit, and ring any polarized bell included therein. Generators of this style are now not often made for signaling purposes. The revolving coils have been discontinued, and a Siemens armature substituted for them. This can not be seen in the usual bell box, except by taking the mechanism apart, because it is completely inclosed *between* instead of *in front* of the magnet poles. But it is indicated by the drawings Figs. 3, 3^a and 3^b.

A couple of iron pole-pieces are bolted to the inside of the magnet poles, and then bored out true, forming a cylindrical chamber, within which the Siemens armature is hung on bearings. Fig. 3^b is a longitudinal view and Fig. 3^a a cross-section of the armature. The core is of iron, and in cross-section has a form like a two headed rail, while lengthways it is shuttle-shaped. The wire is wound lengthways on it, so that the whole practically constitutes a long electro-magnet, the ends of which lap over the wire coils. The two curved faces are the poles of the magnet; these are turned to fit easily but accurately within the cylindrical chamber between the poles, and the two wire ends are connected, the one with the magnet and metallic frame of the

Fig. 3a Fig. 3b

instrument, and the other with an insulated spring pressing on the end of the revolving armature, thus being adapted for easy inclusion in the main line circuit of the apparatus. It may not at first seem clear that this still utilizes the same principle; but it is a fact that it does.

The core of the armature when in place is between the two poles of the magnet and is thus strongly magnetized. One pole face of the armature is opposite, let us say, the north pole of the magnet, and the other therefore is opposite the south pole of the same magnet.

This makes it quite clear that not only is the armature with its longitudinal coils in the very strongest part of the magnetic field, but also that the lines of the magnetic force from one pole to the other must pass actually right through the wire coils and through the iron core of the armature. The pole face of the armature at any moment next the north pole of the magnet has by induction a south polarity, while the opposite side of the armature acquires naturally a north pole, which of course is opposite the south pole of the magnet. Now when the armature is turned round, the entire magnetism of the core is reversed. The polar face which at first was north, has now become south, and that at first south has now become north; thus the coil stretched lengthways over the core has been turned round across the magnetic field, and in accordance with the principles already laid down, currents of alternately opposite direction are set up for each complete revolution of the armature. But we have also seen that the magnetism of the armature is also reversed by turning round, and as the magnetism of an iron core surrounded by a coil of wire can not be changed without setting up (still by the same principle) currents of electricity in the coil, it follows that the two ways of acting upon the coil, namely, the moving of the coil past the magnet pole, acting on the outside, and the change of the magnetic condition of the core acting on the inside of the coil coöperate, and the electrical currents generated are very energetic.

The magneto generator is often required to ring over long distances; and if coarse wire was used to wind on the armature, but a few convolutions could be squeezed into the small space which is at our disposal. Every convolution makes its own portion of the ringing current, and if but few convolutions can be wound on the core, the ringing current constituted by the current of all of the individual currents added together, would be still comparatively weak. For this reason we have to use fine silk-covered wire, by which means a great number of convolutions can be squeezed into a small space, and we get a current of considerable energy, which can ring a polarized bell over a line several hundreds of miles long.

The shuttle-shaped core will be found by anyone who will take the trouble to look, to be made of cast iron. This is not because cast iron is found to work better than wrought iron, but because, while very convenient to make, it being cast into form, and while not very costly, it works very well. It think a stronger current, other things being equal, would accrue from the use of a wrought iron core, because it would be more susceptible to magnetic change, but it would be costly, as it would require forging.

The motion of the crank is conveyed to the armature in various ways. Sometimes a large pulley is placed on the crank axle connecting with a small one on the armature shaft, by means of a belt. Sometimes a pair of friction wheels are used. But the best plan is a well-made gearing, a spur wheel on the crank axle, and a pinion on the armature shaft. The drawing Fig. 4, shows the arrangement in diagram of such a generator, in circuit with a bell which it is to ring, all telephone connections for the present being omitted for greater clearness.

I shall have something to say later about another attachment of the generator, but it will require special attention, and as it has no part in developing the currents, it is thought best to say nothing of it here.

If the crank turns with difficulty, it is probable that the crank shaft wants a drop of oil. One drop of the best sewing machine oil ought to last six months. Sometimes, in generators having a gear movement, the operation of calling may be found a very noisy one. In such a case, the teeth of the wheel and pinion mesh too deeply into each other. In some bell boxes there is an adjusting device whereby this can be regulated.

As with the bell, other defects may sometimes occur, but they can be more easily described when we reach the point where the bell box as a whole can be considered.

But even now, I think it well to state that the permanent magnets should never be taken apart from each other. It is almost impossible that any trouble can arise that pulling the magnets and armature apart can remedy.

(*To be continued.*)

"Practical Telephony" Appreciated.

To the Editor of WESTERN ELECTRICIAN:

XENIA, O., DEC. 15.—With hundreds of others, doubtless, I am much gratified at the prospective benefit to be gained by the study of Thomas D. Lockwood's series of articles in the WESTERN ELECTRICIAN upon "Practical Telephony." They will prove to be valuable chiefly, I am sure, because they promise to be clothed in common and simple English instead of being learnedly obscure through befogged technicalities.

The notion that expert electricians can be created and grown as rapidly as telephones and transmitters and call bells can be manufactured, ought to be exploded. A vast majority of the grand army of employes in the telephone business in this country are novices, never having been trained in the study of electrical phenomena; and many who have given the subject consideration in a general way, know but little as to its practical properties in telephony. Then what is needed mainly, is elementary knowledge, *practically applied;* and prolixity instead of being a fault is the chief attraction in the search for wisdom that is mostly hidden. We, the unskilled and inexperienced, want every essential topic turned over and over and inside out, and around and around—all sides shown up, in plain and simple every-day talk. Not only "tell the truth," but *tell it all.* X.

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The Close of Volume I.

This, the 27th, Number, closes Volume I of the WESTERN ELECTRICIAN and with each copy will be found a Title page and Index designed to be bound with the numbers, making the whole one complete volume.

THOS. A. LOCKWOOD continues his series of articles on "Practical telephony" this week, with a description of the calling generator, illustrating the salient features of the instrument by cuts. We may state at this point that in future, whenever the subject-matter can be more plainly presented to and impressed upon the mind of the learner, illustrations will be liberally used.

A correspondent shows his esteem of the articles in a vigorous article, which also appears in this number. He, too, argues against a possible charge of prolixity, under which Mr. Lockwood thought he might be laid, and manifests a just appreciation of a plain, simple and full presentation of the elementary principle.

MR. STEUART'S paper before the American Institute of Electrical Engineers, at New York, December 20th on "Revision of the patent law" is concluded this week and is accompanied by a *resumé* of the discussion awakened by its presentation and an abstract of the correspondence received by the secretary of the institute in regard to the subject-matter.

The subject, as the discussion shows, received thorough consideration by well-posted men. A careful persual of the paper and discussion forces the conclusion that no better way to secure reforms in both patent law and patent office methods could be devised than by the appointment of a commission of expert patent lawyers who will make their investigations and report their recommendations and conclusions to congress—all of which is embodied in the bill proposed for submission to that body.

THE *Deseret Evening News* of Salt Lake City opposes the idea of governmental control of the telegraph on the ground that it is against good policy, against the genius of genuine democracy, and against the doctrine of decentralization.

The *News* is the official organ of the Mormon church, which is against good policy, is a vast hierarchy and a notable instance of centralization of state power in the hand of the church—all of which are contrary to the genius of genuine democracy and contrary to the other principles upon which the *News* bases its opposition to the idea of a governmental telegraph.

The inconsistency of the *News* is very evident and we must look elsewhere for the true reason of its opposition. Undoubtedly it is found in the statement that the Mormon church owns a system of telegraph lines extending throughout the territory of Utah and into Idaho. And naturally any move that would subject the Mormon church and its vicious practices to the supervision of the government would be strongly opposed by the adherents of that church.

Recognition of the efforts that are being made toward a govermental supervision of the telegraph, a government telegraph independent of existing systems, or government purchase of existing systems, is clearly within the province of any newspaper, and particularly so of one devoted to the departments of industry in which electricity plays the prominent part; hence, the columns of the WESTERN ELECTRICIAN have presented the various aspects of the matter as they came to notice without expressing favor for any plan. Each has its merits and each its disadvantages, but, suffice it to say, the outlook is for a through ventilation of the subject at Washington this winter.

THE race between gas and electricity in Chicago is becoming exciting. The gas monopolists have had things pretty much their own way for a long time, and now just as the electric light is on the eve of being introduced for street lighting, natural gas makes its appearance, forcing itself up from the bed of Lake Michigan just at the opportune moment, and making its appearance in a most fantastic fashion at the end of a water pipe in a brewery on shore, and burning for the last week with increasing energy, after interfering with the water supply for eight months previous; its presence not being even suspected till accidentally revealed by ignition from a lamp. This gives rise to the discussion as to whether the supply is from a permanent source, or only from a pocket of limited capacity. The latter, it is argued, must be the case, since such gas pockets were found in the excavation of the tunnel, while the clay formation under the city and lake adjoining is not such as to retain a permanent supply, which can exist only in a rock formation; and further, that the numerous artesian wells, some of them 2,000 feet deep, have failed to reveal the presence of gas in any considerable quantity.

There is one condition, however, which may have some weight. Natural gas in large quantities has been found in Indiana, only a short distance to the southeast. From this it is reasonable to infer that it underlies the bed of Lake Michigan at a much nearer point directly east of Chicago; and it may be that a rock formation, inclosing an inexhaustible supply of gas comes much closer to the shore than has been supposed, and that this gas which has been discovered, makes its way up through some fissure in a strata inclining upward and inward toward the shore. As natural gas has no smell, it is easy to see why it was not discovered until a light was applied.

A COMMISSION appointed by the New York legislature in 1886 to report on the most humane method of capital punishment, has had the matter under consideration, and is to make its report early in January next, the time having been extended, and it is understood that the electric method has the unanimous indorsement of the commission, and will be recommended. If the death penalty is to be inflicted the demand of modern civilization is for the most humane method as opposed to the ancient methods, which sought to aggravate the culprit's sufferings by crucifixion, burning and similar cruel methods. The French guillotine was an advance in this direction, substituting instantaneous decapitation by mechanical apparatus, for the clumsy cruel method by the ax or sword, wielded by hand.

Death by hanging, even when the neck is broken, is a comparatively slow process, occupying eight to twelve minutes or more; and the same is probably true of decapitation by the guillotine, though we have no means of verifying it by resuscitation, as sometimes occurs in hanging. Cessation of muscular action is no evidence of cessation of life and suffering, as the brain may remain active, producing probably acute pain and consciousness of it, after muscular action has ceased by the severance of the spinal cord, which interrupts communication between the brain and muscles. But death by electricity is believed to be absolutely instantaneous and painless, its action being quicker than the nerve communication with the brain, by which pain is felt. The forthcoming report is to be a full exposition of this entire subject, giving the experience of physicians, reporters and others who have assisted at executions or witnessed them, and also the experience of resuscitated persons; and it will be awaited with interest. If the state of New York takes the lead in adopting the electric method, this interest will be greatly intensified, and the moral effect of such action in restraining crime or otherwise, as well as its humane feature, will be carefully scrutinized by the whole civilized world.

The guillotine, notwithstanding the humane intentions of its inventor, is said to have the greatest terror for the doomed culprit, far in excess of that inspired by the gallows, and the electric shock is dreaded by nearly everyone except the expert electrician. So that if the object of the death penalty is to terrorize, and thus deter from the commission of crime, this mysterious, unseen agency will probably produce that result on the average criminal in an intensified form; while, on the other hand, to the scientific criminal this method will lessen the terror. Hence the question lies chiefly between humanity on the one hand, and moral effect in deterring from crime on the other. And as the method does not lessen the ignominy in either case, which is a chief factor in the moral effect, the most merciful method should have the preference.

WE give this week an abstract of a highly interesting paper on the application of electricity to pumping in collieries, by Frank Brain, which practically covers the whole ground of the electric application of power in mining. This, taken in connection with the item given last week on the electric lighting of the East India railway collieries at Giridhi, shows that this very important subject is attracting attention in all parts of the world.

It is evident that the smoke and escaping steam from an ordinary high pressure engine with boiler and furnace closely attached, would render its use in mines in this manner practically impossible, hence the furnace and boiler, with or without the engine, must be located above, near the mouth of the shaft, and the power applied in the mine below.

This has been done, either by placing the engine below, and transmitting the steam by pipes from the boiler above, or by placing both engine and boiler above, and transmitting the power by cable, compressed air or otherwise.

With the engine below and boiler above, the exhaust steam can be suppressed by condensation, but the condensation of the transmitted steam in pipes several hundred feet long, involves a serious loss, and a heavy expense for piping through long tortuous passages, with constant liability to damage, involving serious delay and additional expense for repairs. Transmission by compressed air with the compressor above involves the same expense for pipes, and the same liability to damage, and in both cases there is also the liability to leakage. Transmission by cable is also uneconomical for long distances. But by the electric method all these difficulties are overcome. The power generated by the engine at the surface can be transmitted with comparatively slight loss and small expense to the most distant part of the mine, and there used for pumping, hauling, drilling, coal cutting, ventilating, or electric lighting; and when not wanted for one purpose, it can be utilized for another. The conductor can thread tortuous passages or straight ones, over rough underground roads or smooth ones with equal ease, and without the extra expense required for laying pipes through intricate tortuous passages. Repairs are seldom required and when required are quickly and easily made. No danger from the ignition of gas is incurred by the use of the incandescent lamp, and no inconvenience from lamp smoke, or foul air, while the superior illumination facilitates all mining operations and cheers the dullness of the miner's life. Finally the whole plant, both for light and power, can be installed rapidly at less expense than any of the old systems, and maintained on the same basis of comparative economy.

Revision of the Patent Law.[1]

BY ARTHUR STEUART.

PART II.

V. A PATENT COURT SHOULD BE ESTABLISHED.—The greatest evil that exists to-day in the administration of the patent system, lies in the lack of harmony between the patent office and the courts of the United States in which infringement cases are determined. Every practitioner before the patent office knows how little regard is paid by the examiner to the decisions of the courts upon questions of patent law, and it has long since become a thing of the past when the courts gave any weight to the presumption of patentability that would naturally arise from the fact of the commissioner of patents having granted a patent upon a device. For the accomplishment of the best results with our patent system, the interpretations and application of the law under which patents are granted should be the same as that under which rights growing out of patents are determined. So that a right granted by the patent office would be sustained by the court, and the rulings of the courts would be in conformity with the spirit of the constitution which has originated the whole system.

Under the existing system, the examiners in the patent office interpret the patent law for themselves, and it has been my experience that few of them agree upon many points. The practical questions which have to be passed upon by the examiners seldom if ever get before circuit courts, but are decided by the commissioners of patents, who, it is well known, seldom possess any knowledge of patent law when they enter upon the duties of the office, and seldom occupy the position long enough to be of any practical service to the office after they have learned something of the law by experience. The result is that a majority of the cases passed upon by the commissioners, and which are intended for the guidance of the examiners, are decided at a time when the particular commissioner is almost entirely ignorant of both the law and the practice of the office. It is, therefore, only to be expected that the examiners should form their own notions of the law and pay little regard to either courts or commissioner, and as the examiners are not lawyers and have no knowledge of the patent law, except such as they may gain from the conflicting decisions of the ever changing commissioners, and as they have had no judicial training, it follows as a matter of course that each primary examiner has his own interpretation of the law and his own peculiar notions of how it should be applied to the practical questions that arise in his daily work. The result is that we have as many different patent offices as we have divisions and scarcely any two of them with the same views of the law, but each having the power and exercising it of issuing patents according to his own individual notion of what the patent should contain and how it should be framed, and these patents thus issued are the title papers upon which the inventors of the country are compelled to base their claims when they come into the courts for the purpose of protecting their property. Is there any wonder that it is difficult to obtain a patent of any value or to sustain and protect it after it is procured? It seems, therefore, to be eminently desirable that the same tribunal——which shall be so framed as to insure its capacitys—hould have appellate jurisdiction from both the patent office and the circuit courts, so that by vesting both jurisdictions in one competent court, the rulings of both branches, the patent office and the circuit courts, may be made uniform, and the anomaly removed that now exists of one branch of the government employed in granting patents and another in destroying them. It may be said that such a court exists at this time, but we all know how far removed the supreme court of the United States is from the patent office and how little influence it has upon its practice, beside which the existing evils have grown up under the present system, which demonstrates its incapacity to remedy them.

A strong, well-selected court of expert patent lawyers, would have many advantages. It would harmonize the patent office and the circuit courts. It would crystallize the practice of the patent office, so that it would be possible for attorneys to form some conception of what that practice was and be able to advise their clients with safety with reference to their rights. The inventor could have some hope that when he had complied with his part of the government contract by disclosing his secret he would be protected in the exclusive right to use it. Such a court would lift a great burden from the shoulders of the supreme court as but a small proportion of cases decided by it would be appealed to that court, and its rulings being binding upon the circuit courts, would enormously simplify the practice in those courts.

The jurisdiction of such a court should be altogether appellate, and should consist in appeals from the board of examiners-in-chief upon questions of anticipation, patentability and practice, from the examiners of interference, upon questions of priority between applicants for patent upon the same invention, and of appeals from the circuit courts of the United States upon all questions relating to patents that now go to the supreme court. It would be proper also to include within the jurisdiction of this court all questions now passed upon by the commissioners of patents, such as trade-marks and labels; copy-rights might also be included. With such a court the duties of the commissioner of patents should be purely executive, and the jurisdiction of the supreme court of the District of Columbia in matters of appeal from the commissioner, should be cut off. The supreme court of the district should bear the same relation to this court as the circuit courts.

Passing from the question of reorganization of the patent office to specific amendments to the law, the first question that presents itself is the question of limitation to actions.

VI. LIMITATIONS.—It is pretty well settled by the courts that since the adoption of the revised statutes of 1874, there has been no limitation to the right of an owner of a patent to bring suit against an infringer for the recovery of damages for such infringement. Prior to that time, the only limitation that existed was six years after the expiration of the patent, and this seems to be the just rule. Many rules for limitation have been suggested, but it seems to me, in view of the fact which all of us have experienced, that the last few years of a patent are often the only ones during which the inventor realizes anything from his invention, that to cut him off from the recovery of damages from infringers, who may have pirated his invention during a period when he was too poor to stop them, would be unjust in the extreme.

VII. DAMAGES.—The existing equity rules for the recovery of profits and damages for the infringement of a patent are in a very satisfactory shape, but since the decision of the supreme court in Root vs. The Railroad Co., these rules do not apply to actions brought for the recovery of damages after the expiration of the patent. Such actions must be brought at law, by an action of trespass on the case, and the measure of damages under that form of action is much less liberal than the rule in equity. In an action of trespass on the case the measure of damages is the actual loss to the plaintiff and not the gain to the defendant; while in equity the rule allows the recovery of either the loss to the plaintiff or the gain of the infringer, whichever may be the greater, and often the difference is very great. If it is just and right that the owner of a patent should have all the benefits that may or can be derived from the use of his invention, and this is the theory of the law, and in one form of action before the expiration of his patent, is allowed to recover these benefits; in the absence of a statute of limitations, why, in justice, should he be deprived of his benefit simply by the expiration of his patent? It would seem as if this evil should be remedied by legislation. It might be done by giving a plaintiff a standing in equity under a bill for an account and discovery, independent of an injunction, or if the patentee were permitted to bring an action of assumpsit for recovery of the benefit that the infringer had derived by the use of his invention, this might be almost as well; but this would require the interposition of a jury, and in complicated patent cases it is difficult to accomplish satisfactory results with a jury. It is almost impossible to make a jury understand mechanical technicalities or for the attorneys to do justice to the case upon oral testimony.

We have at this time a case in point which illustrates this rule. For seven years the owners of certain patents have been in constant litigation seeking to sustain them. We have recently succeeded in getting a decree in their favor, and a month before this decree was rendered the patents expired. The patents have been extensively infringed and cover important inventions. We have now no remedy save to sue at law by an action of trespass on the case. As a matter of fact the owners of the patents have never established a license fee for their use, but if they had, as they might have done, it would not probably have been more than $10 for each machine. Hence, this sum in our action at law would have been the limit of our possible recovery; notwithstanding the fact that the infringer by the use of each machine has saved to himself not less than $500. Why should the rule of law in a case like this be different from that in a case where a man without my knowledge or against my will carries off my horse and uses him for his own benefit for a certain period, after which I recover him? In such a case I bring a suit and the jury estimate the benefit that the wrong doer derived from the use of my horse and awards me this amount as damages for his wrongful act. Would it be right that this wrong doer should have the power of escaping liability by answering when the jury found that he had made $100 by the use of my horse, that I could not in the same time have made but $10 with it? Would not this be putting a premium opon the wrongful act?

The question is still an open one whether in those States where the common law forms of action have been abolished, an action could be maintained at law for the infringement of a patent, the substantial result of which would be the same as the common law action of assumpsit, although the statute prescribes an action of trespass on the case as the proper action.

VIII. REISSUES.—Since the decision of the supreme court in Miller vs. The Bridgeport Brass company and the line of cases that have confirmed this doctrine, it may be said that a reissue, in the sense in which that term was formerly employed, is no longer possible. The unfortunate inventor who has employed, in his ignorance, an incompetent solicitor to procure his patent, or who yields to the unnecessary limitations of the office, and whose patent issues to him covering half of his invention, or possibly contains a disclaimer disclaiming the other half, can be said today to have no remedy for his misfortune; and if two years have elapsed since he procured his patent, or some enterprising manufacturer examines his patent and finding that he has not covered the second half of his invention, proceeds to make and sell that half, he is forever barred from going back and claiming it. Some change in the law should surely be made to enable an innocent and meritorious inventor to secure the full benefit of his inventions, if this can be done without destroying vested property rights in individuals.

Under the present law, when a patent is surrendered in order to obtain a reissue, all accrued causes of action for past infringement upon the original patent go with it, and no action can be brought for an infringement committed prior to the date of the reissue. There does not appear to be any good reason for the existence of this rule.

At present an application for a reissue must be signed and sworn to by the inventor. This rule puts it into the power of a dishonest person to extract money from the owner of the patent by refusing to sign the reissue papers. The owner of a patent should have the power to deal with his property as he chooses, and as he is considered, when he purchased the patent, to have purchased all that could have been covered by the inventor's original application, if the patent does not do this, he should have the power to reissue his patent upon his own petition, and an oath that he is the sole owner, or if there be several, that they own the whole title.

IX. REPEAL OF PATENTS.—The statutes of the United States contain no provision which will

[1] Read before the American Institute of Electrical Engineers, New York, Dec. 20, 1887.

permit a patent supposed to have been obtained by fraud or mistake, to be set aside, nor for any action by the United States against the owner of such a patent to prove the fraud and have the patent declared void. The statute should contain such a provision.

X. EQUITY PROCEEDINGS FOR SLANDER TO PATENT.—Neither statute nor precedent in this country authorizes an equity proceedings for an injunction to restrain the continuance of slander against a machine or a patent, by one who falsely charges that the machine or the patent is an infringement of another patent owned by him, and threatens suit for such infringement, but neglects to bring such suit, and who thus continues to disturb the business of the party slandered without attempting to execute his threats or to vindicate his claim. Such an injury can not adequately be remedied by an action at law for damages. What is wanted is an injunction from a court of equity to stop the tongue of the slanderer at once and forever.

XI. LICENSES.—Licenses should be recorded and subject to the same rules as mortgages of land; the license first recorded should take precedence.

XII. JOINT OWNERS.—The mutual rights of joint owners of a patent are in a very unsettled state in the present condition of the law, and it would, I think, be much safer to say that joint owners are entirely independent of one another, —although there are some cases to the contrary,—than to venture any statement with reference to what those mutual rights may be.

It would seem that no good reason could be advanced why joint owners of a patent should not bear the same relation to one another as joint owners of any other property. If two persons own a house jointly, but in definite proportions, and one of those persons rents the house and receives the rent for it, the other can, of course, receive his share of the rent either from the person or from the property. The absence of well-settled rules upon this subject makes it very desirable that they should be established by statute.

XIII. UNITED STATES PATENT LIMITED BY FOREIGN PATENT.—United States patent should not be limited to expire with the shortest lived foreign patent upon the same invention, for the simple reason that the American inventor who gives his invention as a free gift to the foreigner, gets a patent here for 17 years, while he who seeks to protect himself abroad may limit his United States patent by several years.

XIV. ASSIGNMENTS.—Assignments of patents should stand upon the same footing as conveyances of land; the assignment first recorded should take precedence.

XV. EXPENSE OF LITIGATION.—Expenses of the trial of patent cases might be lessened if the court was authorized, in impaneling a jury as provided by the act of 1875, to impanel a jury of five expert persons in the subject-matter of the case, pay them a suitable per diem, let them hear the testimony and advise the court. Cochrane vs. Deener, 4 Otto, 784.

XVI. INTERNATIONAL CONVENTION. — The United States by its adherence to the International convention pledged itself to adopt legislation as soon as possible to harmonize the existing law of this country with the international law. The practical result that Americans need in relation to foreign patents is a period of say six months after they have secured an allowance of their United States patent to make their applications abroad without affecting the term of their United States patent.

I have thus rapidly touched upon the points in our patent law that need revision, without attempting to formulate specific additions to the statutes. This, I think, can only be done effectually by a commission of expert lawyers, such as is contemplated by the bill that we propose to introduce into congress. In order to secure the passage of that bill, we will need the aid of every man who is interested in this subject exerted to the fullest extent. We would most earnestly urge the importance of this effort in its possible effects upon the country, and solicit your assistance in making it successful.

The presentation of the paper brought out the discussion and correspondence, of which a *resumé* is given.

THE PRESIDENT: This subject is one, I may say, that lies well within the province and jurisdiction of the American Institute of Electrical Engineers. It has been brought before us on various occasions, and it is somewhat interesting to recall the fact that at our very first meeting, held in this room for purposes of organization, now close upon four years ago, almost the first question that was introduced to our notice was that of patent reform, when C. J. Kintner, of the patent office, presented a spirited appeal to us for aid in bringing about certain reforms which he then deemed necessary. Since that time we have had valuable and forcible papers presented before the institute by Frankland Jannus, and by A. C. Fowler, both of whom brought out very ably the necessities of the situation at the time. It will thus be seen that the institute is well prepared to consider the subject in all its bearings and relations, and is ready to ascertain from Mr. Steuart just what work the National Electric Light association now proposes with regard to this bill to be laid before congress. I may say here that I have myself had the opportunity of attending all the meetings of the National Electric Light association at which this question has been brought forward, and I think I may take the liberty of saying that that society does not intend to act with any undue haste or precipitancy in the matter but is likely, in fact, is sure to proceed with its accustomed practicality and business-like common sense. Our position to-night is one in which we may be able to do great good in the direction of showing how far this movement is calculated to receive the support and sympathy of scientific and professional circles, especially those that are connected with electrical interests.

GEORGE TICKNOR CURTIS, on the invitation of the president, detailed his own work in the matter of securing patent office reform, and mentioned an interview he had had in regard to it with Senator Platt, of Connecticut. He closed as follows: "It would take me half the night to touch all the points, or half of them, on which it seems to me the time has come for this kind of action. My situation and occupation of late years have led me to bestow a great deal of attention on the course of the supreme court in the administration of the patent law. Unfortunately—I do not know how it has come about exactly—but the present court has gone to very great lengths in overturning all the great doctrines of the patent law that were settled forty years ago when I first began to practice, and that is more than forty years ago. There have been decisions, which of course must stand as the law until congress shall interfere and declare the law otherwise. Well, that is one great part of the task which such a commission would have to perform. They would have to examine all these cases and see whether they are or are not consistent with the fundamental principles of the law as it has been construed heretofore. The statute law is substantially the same to-day as it was when enacted in 1833. There has not been any very material change. But there is a very great departure in the doctrines which are held now by the judges of the supreme court from what seemed to me to be the sound and true doctrines of the law, and I hope you gentlemen will go ahead and get your bill passed, and then secure as suitable a commission as you can. I have a copy of the bill of the last session which I will hand to the president. I suppose that your bill, which in some respects is a better one, will go at once to the house committee, and of all suggestions I should respectfully recommend that you avoid the appearance of aiming at any particular point, any particular change in the present system of patent law more than others. The paper goes over a great deal of ground, specifies a great many different points. Well, there would be differences of opinion, of course, about those different matters. In a great deal of it I agree. I do not know whether I should agree with every part of it, but if you can present your application in such a way as not to allow the committee to have the idea that you have any ax to grind for yourselves or anybody else in respect to any specific question, why I think there is no doubt but that you will succeed in carrying the measure which you wish to.

THE PRESIDENT: It has been very interesting indeed to have these remarks from a gentleman so well known and whose experience extends over a period of well nigh half a century. In listening to such mature advice and in governing ourselves by it, we certainly can not go very far amiss. Mr. Curtis, in his remarks, made allusion to an interview that he had had with Senator Platt. I may state that a few days ago I wrote myself to Senator Platt, calling his attention to this movement which had been set on foot by the National Electric Light association, and which we proposed to bring within our purview, and I asked his opinion of it, saying that we would be very glad if possible to have his attendance at the meeting. I would like to read his reply. It is as follows:

"I have your letter of the 15th, expressing your desire that I be present at your meeting next Tuesday evening in New York. It will be impossible for me to leave Washington at that time.

"With regard to the proposed revision or amendment of our patent law, I can only say, generally, that while I think some amendments are very desirable, it is very doubtful, first, whether such amendments as are desirable can be obtained at the hands of congress, and second, whether any attempt to radically amend our patent laws would not result in the passage of laws calculated to injure the interests of inventors and the public. I say this, because my observation leads me to believe that probably two-thirds of the members of congress are more or less prejudiced against patents and against certain desirable features of the patent system, and during all my experience in the senate, it has been my effort to prevent congress from passing laws which would be disastrous. No man can predict the outcome of an effort to amend the patent law. It may result in what we deem the advantage of the public. It is quite as likely to result injuriously to the public. I have been made to feel very many times that perhaps it was better to bear the ills we have than fly to others we know not of. In saying this I do not mean to imply that I am not in favor of amendments, but simply to indicate the danger that always confronts us when we attempt to legislate with reference to patents.

"Very truly yours, O. H. PLATT."

We have, however, a representative of Connecticut with us in person this evening. I refer to Albert H. Walker, and his views on this subject would be likely to interest us very greatly.

MR. WALKER: I have listened with great pleasure, as we all have, to him whom we regard as the father of us all, speaking of ourselves as patent lawyers, or as interested in the development of the useful arts. The pamphlet that I see in the hands of some of you, and which I suppose has been read by most of you, contains an article by myself which sets forth the principal part of my views touching the desirability of revising the patent laws. It will therefore not be expected that I will elaborate my opinions upon the subject upon this occasion; but I shall be glad with your permission to make some observations touching the expediency of pressing them to revise those laws. I do not agree in the slightest with Senator Platt. My experience in the attempts that have been made to secure from congress the revision of the patent laws, dates to a considerable period earlier than that of Senator Platt, and with all deference to him I think it has been more extensive than his has been, because during his occupany of a seat in the senate no such effort of any degree of seriousness has ever been made. Ten years ago now, the celebrated bill 300 was before congress—the 45th congress. Its forerunner was before congress eleven years ago—the 44th congress—and very strenuous effort was made to pass that bill. Very large amounts of money were expended in employing distinguished lawyers to go to congress and secure the passage of the bill. It was not at all favorable to the patent system as a science. It was advocated by men who had axes to grind. It was advocated by men of very great ability who had clients who contemplated plucking certain prospective prey of theirs, and it failed, because it was a bad bill, and I think that a bad bill can be relied upon to fail in the American congress, upon the subject of the patent laws. A great many have failed, and I think they all will fail. Why? Because there are so many intelligent men in congress, and because there are so many intelligent men in the United States, who can explain things to the intelligent men who are in congress. If we are ever going to make an effort to secure a revision of the patent laws, no time is more opportune than this. I read this afternoon on my way here from Hartford, an editorial published in the December number of the *Electrical Engineer*, taking the view of this subject which is taken by Senator Platt in his letter. The senator indicated in that letter his opinion that a congress which sits pending a presidential campaign and pending the counting of an electoral vote, is a very inopportune congress to which to apply for a revision of the patent laws. But half of our congresses come within that category. Half of your congresses sit in the last half of a presidential administration, and the other half in the first half of a presidential administration, and those congresses which sit in the last half of presidential administrations are generally understood to attend chiefly to presidential elections rather than to the public business; and for that reason the editor of the *Electrical Engineer* expressed the opinion that it is hopeless to expect any thing in the way of important legislation from that congress. I am inclined to agree with him, and therefore I advocate that that congress be the congress that be invited to pass the bill providing for a commission, and that the 51st congress, which will not be trammeled by such considerations, be the congress that be invited to enact the bill which shall be recommended by that commission. It is impracticable in my judgment to secure from any one congress the passage of the bill to appoint a commission, and also the enactment of the legislation which may be recommended by that commission, because the time which passes after a particular congress assembles and begins business before that congress adjourns is less than fourteen months, and that is too short a time in which to secure the passage of our bill or of any bill for the appointment of a commission and for that commission to pass through its deliberations and produce its report and have congress to intelligently act upon the bill which may be recommended by that commission. In point of fact those three things never will be done in any one congress. Therefore the obvious plan is to ask one congress to appoint a commission or provide for the bill appointing a commission, and the succeeding congress to pass upon a legislation that may be proposed by that commission, and that is the scheme of the bill which appears in your pamphlets as having been advocated by the National Electric Light association."

Mr. Walker then went on to express his belief that the idea prevalent in some quarters as to hostility to patents was an exaggerated and even unfounded one. He had never met anybody opposed to the patent system.

MR. CURTIS: I may give my friend from Connecticut a single instance such as he never met with. A great many years ago, before the war, there was a senator in congress from North Carolina, Mr. Badger. He was a very eminent lawyer—general lawyer—and a most admirable person. I was conversing with him one day about a bill that was before congress. I do not recollect whether it was a special bill or what, but it had relation to some changes in the patent law. "Well," he said, "all I know about the patent law is this. Some infernal Yankee comes down to my country and mouses around my back yard and looks over the fence and he sees something in use there in my garden, and he calls out to me and says, 'Stranger, I have got a patent on that; you will have to pay me ten dollars for the privilege of using it.' That," he said, "is all I know about the patent law, and all I want to know." "Well, I said, "Senator, you are here to legislate for the people of the United States; you are in the highest branch of the legislative department; now that is not worthy of you or the state you represent. Now, you just take this subject and look into it, and you will find that there is a great deal in it that you

ought to know, and that you ought to be able to give an intelligent vote upon." He did so, and he was entirely convinced that he ought to know something more about the subject than he did. That is the only instance of the kind that I have met with.

G. M. PHELPS, jr.: I have a letter here from Mr. Kintner, which I will ask the secretary to read, and after he has read it I will have a word or two to say:

The secretary then read the following letter:

"GEORGE M. PHELPS:

"MY DEAR SIR: I am in receipt of a communication from R. W. Pope, secretary of the American Institute of Electrical Engineers, advising me of the discussion touching the question of a revision of the patent laws on the 20th inst., and inviting me to be present and express my views in relation thereto. I hoped that it would be possible for me to be with you upon this most interesting occasion, but business engagements will keep me in Washington the greater part of next week. This matter is of momentous interest to all inventors and persons interested in patent property.

"Some years ago I had the honor to call the attention of the society to the wants of the patent office and the necessities of material changes in the patent law. I have noted with interest all that has been done by the society, and am gratified at the fact that the committee appointed by it has succeeded in putting matters in a tangible shape to go before congress. While the scheme proposed by this committee is, in my opinion, entirely practicable, I have some hesitancy as to the feasibility of its presentation to congress at this time, and am in hearty accord with the views expressed by you in your editorial in the December number of the *Electrical Engineer*.

"During my official connection with the patent office as its chief clerk I very naturally became pretty well versed with the political phases of all matters appertaining to the conduct of the bureau. It is needless for me to say here that in matters of politics individual personal interests control individual members of congress, and that upon the eve of a great national election such as occurs next November, we cannot afford to run the risk of losing everything in a proposed change of existing laws. I therefore beg that you will present the following resolution to the society and urge its passage:

"*Resolved*, That it is the sense of this society that it is unwise at this time to seek by legislation to in any way modify the existing patent system, and that any movement to that end should be postponed until after Nov. 1, 1888.

"I am sure that this resolution will meet with the full approval of every one who has the good of the patent system at heart.

"Very respectfully yours, C. J. KINTNER."

Mr. PHELPS deprecated very forcibly any present action, and remarked: "I may say that if we could feel quite sure that the commission would be headed by Mr. Curtis, and composed of men like him and Mr. Steuart, we should have no hesitation as to their part of the work. The hesitation comes in as to what would be done with it after they had formulated it, and it seems to me we have little to expect from any very early congress. The bills to reform other features of the national polity have not always fared very well at the hands of congress. I do not know why I should feel so thoroughly certain of having a wise and discriminating action taken by that body upon a measure to reform the patent law."

A. C. FOWLER: I have understood from good authority that three-fourths of the manufacturing interests of this country are based on patents, and I think that in the electric art we can safely say it is nine-tenths, because nearly every electrical appliance is patented in one way or another. Up to date there have been 375,000 patents and nearly 12,000 electrical patents, making one-thirtieth of the entire number of patents granted by the United States electrical. Most of these electrical patents have been granted within the last ten or twelve years. There are about 25,000 applications patented every year—nearly that number—and about thirty thousand filed. In the electric art there are about 4,000 electrical applications a year, or about seventy-five per week, averaging about a dozen a day. I think this will show the importance of this subject to electrical men. That is the reason I mentioned it to-night. It would be safe to say that almost 10,000 of the 12,000 electrical patents that have been granted to date have been granted within the last ten or twelve years, averaging nearly a thousand electrical patents for each year during the last ten years."

Mr. Fowler then spoke warmly in defense of the patent office examining corps, and contended that if the examiners were better and fairly paid, many, if not most of the existing evils touched on would be remedied. He approved, however, the idea of establishing a patent court.

T. D. LOCKWOOD said that with all the evils of the patent law of the United States it is yet the best law of the kind in the world, and his experience was that it was not one-tenth as immoral as the patentees themselves. On the whole he was in favor of letting well enough alone and was very much of the opinion of Mr. Phelps and Mr. Kintner that at the present time it would be unwise to try to get any patent legislation.

FRANKLAND JANNUS thought that while the patent law was good generally, there ought to be entire divorce between American applications and European ones. As to the recent International convention, it was absolutely inoperative, because the American representative actually did not know the difference between the filing of an application and the granting of a patent. Mr. Jannus proceeded to touch on a variety of minor reforms necessary in the work done inside the patent office, in order to secure greater facility and accuracy of "references," and to insure greater uniformity of practice. These he thought would accomplish much, even if no effort were made to secure the broader revision desired. If it were intended, however, to apply for a commission, this time was probably as good as any other. Mr. Jannus having remarked that he never knew an incompetent examiner dismissed, Mr. Lockwood added that he did not think anybody did. It was always the competent examiners that got out of the patent office.

Mr. FOWLER: I think if the National Electric Light association were to present some bill in congress which would increase the pay of examiners, say fifty or one hundred per cent., it would go a great way toward removing the evils of the patent office than everything else combined. In one year we counted among the examiners and found that twenty-three of them resigned, about one-sixth of the whole corps. The patent office now is filled with new men. Until a man has examined for one year he is absolutely worthless in the patent office. I have been troubled a great deal myself since I have been out of the patent office with these questions of form, and I know exactly what it means. If gentlemen here had any conception of the work that is thrown upon examiners they would know what it means. It is a great deal easier to raise a question of form than it is to go down and examine the merits of the case. These questions of form are raised by men who are so banked up with work that it is anything to get rid of a case. If the salaries of these men are raised, and men are kept there who can perform three or four times the work that new or inexperienced men can perform, this reform will follow. I was talking with an examiner, a friend of mine, whom I met in New York a few days ago, and he said this is the way to work—and I thought it was a very poor one—it is anything to shelve a case. He has little rollers—stamps—that he rolls across the paper, the division, record, process and everything—*ex parte* something—he rolls them over the sheets and hands them over to the clerk, and she writes a letter. That case is got rid of. I was very much struck with this question of form when I was in the patent office. There was a case which had been on its merits twice to the board and once to the commissioner, and it was a case we were very much harrassed about. It was a question whether the thing was patented, and one of the gentlemen in charge asked me to take hold of the case, and make an examination upon its merits. I took hold of it, spent some little time at it, and I found two English patents for exactly the same thing, and yet the case had been appealed to the board twice and to the commissioner once upon the question whether the thing was patented. That just illustrates the point exactly They will raise these questions of form to get rid of the case rather than examine its merits, because it looks too long. They want to be up to date with the work as nearly as possible.

Now this question of limiting American patents by foreign patents does not strike me as being such a terrible thing. It is easily gotten around. It is the popular impression that all foreign patents limit an American patent, and yet it is only so when a foreign patent is previously patented. It is easy enough to file your foreign patent on the same day that the American patent issues, and the foreign patent does not limit the American patent, nor does the American patent limit the foreign patent in any way.

I am a believer in compulsory licenses as they have them in England. I do not think one man should be able to get a broad claim allowed and prevent improvers from using improvements. That is what the laws of this country give them. In England a board of commissioners decide how much a license is worth, and they make a man with a foundation patent give a license to another party so that an improver can use his invention. There are lots in this country who have valuable improvements locked up in their safes. In that way they impede progress. I have in mind one company who say they don't want to change the machinery, although there are a great many inventions in their line that are better than the devices they use; and they buy up such patents and put them in their safes.

Mr. MILLER said that after he had been to Germany to appeal on some patent cases, he came back satisfied with the office and the practice in America, though he had been dissatisfied before. He was not in favor of high pay generally for the examiners, but for a merit system, and he believed that something might be done in regard to a patent court.

E. C. DAVIDSON remarked that there was no system for the administration of affairs among men so perfect that it was not open to objection by theoretical perfectionists. Probably, too, attorneys quite as much as examiners were tainted with original sin. "The question we must come back to is this: Is not our patent system, as we have it to-day, the best that we can get, with some trifling corrections, and would it be wise for us to open the door to a general revision of the entire system and invite changes which will require interpretation, which will require decisions to mark down all the lines of how they are to be interpreted, and overflow a doctrine in regard to patents based upon some three thousand or more judicial opinions? I think not. As soon as a revision of the laws is invited by a commission, such as has been suggested, every man in regard to the patent law will appear, or combine with others, and appear before such a commission and seek to grind his own axe. We will have before such commission all the gentlemen who are in favor of protecting innocent purchasers. It seems to me I may be permitted to bring the discussion to what I understand to be the real point of it, that is the propriety of making an application to congress for a revision of the laws. Everybody assumes that there are some imperfections. I should think we ought to treat them like any other business enterprise. No business man goes to another and says: 'I have got a claim against you; I don't know just what it is, but if you will help me to find out I think we can get it.' This is no way to get it. We ought to decide what we concede to be the points to be secured for the improvement of the patent system, and then, when we know just what we want, to go and ask for it, and let the manufacturing interests, and the inventors bring their influence to bear upon the politicians. I believe in practical statesmanship. I do not believe in ideal statesmanship. Let us select those things which are obtainable and make a direct application for them."

The resolution proposed by Mr. Kinter was here brought up, but upon motion was laid upon the table.

The subjoined is an abstract of part of the correspondence received by the secretary of the Institute on the subject:

Prof. ELIHU THOMSON was in favor of any movement calculated to improve the patent system. He recommended the remodeling of the law relative to the bearing of foreign patents upon home patents. He pointed out how, very often, inventors under present conditions had to apply for and take out "just such patents as involve no invention, but only aggregation and mechanical skill" for self-protection, "to prevent being harrassed in the development of their real inventions by the pseudo inventor or quasi mechanical improver." He added: "I seriously doubt whether any patent system can be devised which will not in many particulars become outgrown in a moderate period of years. Our present system seems in many respects to have been so outgrown, and if not revised will become more outgrown as the needs of the industrial arts develop in new lines."

EMILE BERLINER would like to see better salaries for the Patent Office staff, a patent court established and a provision that no citizen of a foreign country should obtain a United States patent for a longer period than an American citizen can obtain one in the said foreign country.

E. E. RIES favored revision and proposed that an inventor should be given at least a year within which to secure himself abroad. He also wished to see the erasure of all laws as to the working of patented inventions within a specified time, it being "to the self interest of the owners of a patent to work the same as early as possible, if it is worth working at all."

E. N. DICKERSON, JR., considered that it would be exceedingly disadvantageous to attempt to meddle with the patent law at present. He thought that the system of taking depositions in patent cases "amounted very frequently to a substantial oppression of the weaker by the stronger." A plan perfectly feasible would be that all depositions in patent cases should be taken before a master or referee, with power to rule upon the admission of evidence. Reform in this line would decrease by one-half the cost of patent litigation.

G. H. STOCKBRIDGE was of the opinion that something in the nature of the patent court proposed by the National Electric Light association was the best thing yet brought forward to secure uniformity of practice and decision in the Patent Office. He pointed also to certain reforms desirable in the interest of inventors in the matter of reissues "There should be some law framed to make the government entirely responsible for any abuse of power or any false judgments relating to patent applications on the part of examiners. I would have this also extend to cases of fraud. It is not good morals and ought not to be good law for one party to a fraud to repudiate the consequences of it. Whenever, by reason of fraud, a patent issues to one who is not the first inventor, the wrong can be righted by legal means already provided. But whether there be fraud or not, the government can not justly disclaim for itself a responsibility which it insists upon on the part of the inventor. The injustice of the present ruling is apparent when one reflects that it is often impossible to get from the office claims co-extensive with one's invention, and that there are penalties for delay in the prosecution of an application."

W. A. ROBINSON thought that if the matter was urged, "the probability is that what we shall get will not be what we ask."

MELVILLE EGLESTON regarded the proposed inquiry as an important one, and urged strenuously that the patent office should have control of its own earnings.

F. R. HARDING favored thorough and immediate changes, and proposed making the patent office a separate department, with a commissioner appointed for life, as judges are, and with an adequate salary. The rules of practice should be revised and rendered more specific and lucid. He condemned the system with regard to foreign patents.

The Cost of Lighting Factories by Electricity.

Some interesting figures on this subject have been published by Messrs. Jrénée, Brun & Co. silk and lace manufacturers, of Saint Chamond, France, and reprinted in *Industries*. The mill used to be lighted by 540 gas jets, at an annual cost of £800 for gas, to which must be added £120 for interest and depreciation on the gas fittings. Eighteen months ago gas lighting was superseded by an electric plant consisting of an Edison 450 ampere 100 volt dynamo, 600 Swan and Edison lamps, and steam power for 90 horse power. The following is in round figures the cost of installation:

	£	Per lamp. £	s.	d.
Steam power, shafting, &c., and foundations	1,280	2	2	7
Electrical plant, dynamo, wiring, lamps and fittings	920	1	10	8
Total	£2,200	£3	13	3

The annual working expenses, ascertained from the experience of the last eighteen months, were:

	£	Per cent of total.
Depreciation on plant 10 per cent	220	44
Interest on plant, 5 per cent	110	22
Fuel	48	10
Petty stores	10	2
Broken lamps	108	22
Total	£496 per annum.	

The American Electric Girl.

BY J. H. STEDMAN.

A maiden fair to see, I know,
Of loveliness the essence;
Him upon whom her arc-lights glow,
She turns to incandescence.

When first we met, a shock I got;
But held on, just to test her:
Alas! I'd left at home, forgot,
My "sole lightning-arrester."

The keenness of her brilliant mind
Makes her o'er others tower;
Who sparks this girl of mine, will find
Two thousand candle-power.

Her silken tresses rippling flow,
You ardently admire;
Her small coquetting dynamo
Is wound with "thirty" wire.

Soft as the sweet magneto-bell
Her influence on you switching,
Your watch don't know what time to tell
Her volt is so bewitching.

Winds of despair and storms of doubt
May struggle to benight her;
Should Fates combine to put her out,
Joy comes with her re-lighter.

Two pretty feet on equal poles,
Nimble and quick denote her
The envy of all rival souls,
Who else has such a motor?

When longing nearer joys to taste
I strive with brave insistence,
Why will you fix about your waist
Shunt-magnets of resistance?

Ah, alternating-current girl,
No praises can be flattery:
Short circuit, dear, and cease to whirl,
Make me your storage-battery.

And, dearest, should you rather not
Accept my offering votive,
Might I most humbly ask you Watt
Was your Electro-motive?

To several circuits hereabout
You are the Central Station:
Would I all others could cut-out,
You lovely installation.

Soft nestled in your armature,
Lulled by your soothing brushes,
Your commutator's drowsy hum
All earth's excitement hushes.

No more my carboned heart would roam.
Sweet girl, these wishes grant me!
Reduce your current to *one* ohm,
My isolated plant, be.

Were I Am-Pere and she Gramme-Ma
With insulation rounded,
We'd charge some unfrequented star
And live there till we grounded.

—*New York Graphic.*

A New Experiment in Magnetism.

The circular magnetization which is developed in an iron wire while conveying an electric current, has not hitherto afforded any direct experimental proof of its existence. Its effects in increasing the self-induction of the wire have been dealt with by Prof. Hughes, Lord Rayleigh, and others. We may also mention the proof afforded by Wiedemann's experiment on the longitudinal magnetization of an iron wire conveying a current when submitted to torsion. But owing to the magnetic circuit being closed in the iron itself, direct experimental evidence of circular magnetization was not forthcoming. A very simple and conclusive experiment has, however, been devised by M. Paul Janet, and formed the subject of a note recently presented to the French academy by M. Mascart. M. Janet takes a cylinder of iron 30 centimeters in length by 1.5 centimeter in diameter, which has been cut longitudinally in halves and fitted together with great nicety. A current of from 30 to 50 amperes is passed through the cylinder for a few seconds. The two halves are then separated. A sheet of paper is placed upon one of the two plane sections, and dusting iron filings on this we find that, except near the ends, the filings arrange themselves in straight lines perpendicular to the two generating lines of the cylinder which form the longer sides of the rectangular boundary of the section. At the two extremities of the section the filings are arranged in curved lines, with their convex sides outwards. This shows clearly that the two generating lines are the *loci* of the poles of a series of semi-circular magnetic filaments, so that the whole cylinder must be built up of a series of annular magnets concentric with the axis, and magnetized with an intensity increasing with their distance from the center, which is the distribution of magnetism indicated theoretically. A further verification may be obtained by suspending a magnetized needle parallel to one of the plain sections placed horizontally, when the needle will set itself perpendicular to the axis of the cylinder.—*London Electrician.*

The Turbo-Electric Generator.

This novel machine, of which eighteen different sizes were exhibited at the Newcastle exhibition, consists of a dynamo, the armature of which is attached to a long steel spindle, which revolves in the center of a horizontal cylinder into which steam is admitted by a pipe with a flexible joint, the exhaust pipe being of indian rubber. This spindle carries a great number of brass disks, which rotate between fixed disks attached to the interior of the cylinder; these disks are cut into heliacal teeth or blades, set at an angle to the axis of the cylinder, the pitch of the rotating blades being opposite to that of the fixed blades. The current of steam passing through the cylinder produces the rotation, the speed varying from 9,000 to 10,000 revolutions per minute. The e. m. f. is regulated by a connection with the steam valve by which the speed is varied,—a mode of regulation claimed to be prompt and effective. The machines are of extremely small size and weight relative to their output; an output of 32 electrical horse power being obtainable from one 10½ feet in length by 1½ feet in breadth. A small machine running a lamp of 1,000 candle power besides several smaller lamps was exhibited, suspended by three wires.

Lamp Lighting Schedule.—Moonlight System.

Appended is a lamp lighting schedule—moonlight system, for the month of January, 1888, applicable in Illinois, Indiana, Ohio, Iowa, Nebraska, Pennsylvania, New York, New Jersey, Rhode Island, Connecticut, and practically for Kansas, Missouri, Colorado, Wyoming, Kentucky, Maryland, Delaware, Virginia and West Virginia.

The time for commencing to light is calculated at one-half hour after sunset, or one hour before moonset; the time for extinguishment one hour after moonrise or one hour before sunrise.

The time for lighting or extinguishing is given for the day on which the night commences.

The time up to 12 o'clock midnight is shown by bold face type; after midnight by light face type.

JANUARY.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	**5.10**	**8.20**	3.10
2	**5.10**	**9.30**	4.20
3	**5.10**	**10.30**	5.20
4	**5.20**	**11.40**	6 20
5	**5.20**	12.50	7.30
6	**5.20**	2.00	8.40
7	**5 20**	3.10	9.50
8	**5.20**	4.20	11.00
9	**5.20**	5.30	12 10
10	**5.20**	6.20	13.00
11	**5.20**	6.20	13.00
12	**5.20**	6.20	13.00
13	**5.20**	6 20	13.00
14	**5.30**	6.20	12.50
15	**6 40**	6.20	11.40
16	**7 40**	6.20	10.40
17	**8.40**	6.20	9.40
18	**9.40**	6.20	8.40
19	**10.30**	6.20	7 50
20	**11.30**	6.20	6.50
21	12 20	6.20	6 00
22	1.20	6.20	5 00
23	2.20	6.20	4.00
24	3.10	6.20	3.10
25	4.10	6.10	2.00
26	No.	light.	0.00
27	"	"	0 00
28	"	"	0.00
29	**5.40**	**7.20**	1.40
30	**5.40**	**8.20**	2 40
31	**5.50**	**9.30**	3 40
Total number hours,			216 40

Electric Fishing Rods.

Wolf & Birks, of Berlin, Germany, manufacture electric fishing rods which are highly recommended on account of the results obtained with them. The fishingline and hook are connected with a small incandescent lamp and a galvanic battery. The incandescent lamp is fastened at the end of the fishing-line directly above the hook and attracts the fish. The whole apparatus costs about $7.

CORRESPONDENCE.

New York Notes.

NEW YORK, DEC. 24.—Public interest in the new Edison phonograph has been thoroughly awakened by numerous newspaper articles, and if the instruments prove capable of accomplishing one-half of what it has been claimed that they will do, we may look for a revolution in business methods. Probably no invention has ever been received or will be received with so much general interest, and your correspondent is pleased to be able to state that E. T. Gilliland, of the Phonograph company, promises that the instruments will be in the market by the middle of January.

From Baltimore comes a report that some gentlemen there have formed a company, to be known as the Electrical Dispatch company, for the purpose of developing an invention which it is claimed will revolutionize the common carriage business of the world. Drawings have been made and a caveat filed, but the details are to be kept secret until the company is fully organized, and patents secured in this and other countries. The scheme is to erect an elevated framework between cities, and upon rails on this framework to propel, by means of an electric current, a car or cartridge capable of holding merchandise and mail matter of every description. The invention provides for lubrication as the cartridge rushes along. The inventor claims that a load of newspapers could be landed in New York in a little over an hour and a quarter after leaving Baltimore. This is the report, but it would seem to an observer that the capitalists and inventor of the Electrical Dispatch company would have their hands full in putting such a scheme into practical operation.

A number of business men in New York who lease Western Union and Baltimore & Ohio wires to Chicago, propose to prevent a return to the rates that prevailed before competition, by putting up lines of their own. The average rental is now $15,000 a year, as against $24,000 before the B. & O. cut rates, and now that competition is disposed of it is feared that the Western Union will, as soon as the present contracts expire, raise the rental, if not to the old figure, to a price largely in excess of what is now charged. These gentlemen have at last agreed upon a general plan, and propose to carry it out without delay. It provides for the formation of a joint stock company, with a cash capital of $500,000, which sum it is claimed will be sufficient to construct all the wires necessary. The operating expenses, it is calculated, will not exceed $100,000 a year, and, as there are 50 subscribers, the original subscription will be $10,000, and the yearly assessment only $2,000.

The Electric railway, Van Depoele system, between Brooklyn and Jamaica, is now in practical operation, and is giving the best of satisfaction. The success of this road has undoubtedly aided the South Brooklyn Street Railway company in deciding to use only electric motors on their new lines.

The C. & C. Electric Motor company are now making motors of the smallest size, ⅛ horse power, which are automatic in their regulation, and of constant speed. The smallest motors of this class that they have sold heretofore have been not under half a horse power. The new small motors are particularly adapted to the driving of single jewelers' lathes and dental engines, and doing other light work.

The Union Fire Alarm company, 145 Broadway, New York, have completed their contract with the city of Altoona, Pa. The fire alarm system is a most complete one, and consists of 35 boxes, 6 recorders, 6 indicators, 6 large gongs and 2 tower strikers. The cost to the city is about $5,000.

The Sprague Electric Motor company have just received an order from Pittsburgh for two motors, 40 horse power each, for running ventilating machines in the new court house. Mr. Harding states that one of their motors in Pittsburgh, furnishing power for the telephone exchange, has been running for six months, day and night, without stopping. A.

From Kansas City.

KANSAS CITY, Mo., Dec. 24—A subject which interests all district telegraph companies is a system or method by which messengers are compelled to complete a service within a given time, first, as a matter of economy, secondly, as facilitating the prompt delivery of messages, which is of importance to the subscriber, and the prompt return of the messenger to the district office, which is of importance to the company. The system used by the Home Telegraph & Signal company, of this city, is one which has given great satisfaction both to the company and its patrons. The arrangement of the tariff book is such that one can see by a glance at the rate sheet, the rate or price allowed a messenger for a given service, the time in which the messenger must complete the service, the distance to a given point and return and the nearest cable line on which he must ride. As a matter of fact there is no guessing in regard to the return of the messenger. The time allowed is twenty minutes for each mile—walking time—and it is found quite satisfactory. A satisfactory fire alarm test was made from the Centropolis hotel over a direct wire connected with J. C. McLaughlin's annunciator system, during which time the department made a run of 2,340 feet, laid 250 feet of hose and had water on the building inside of one minute and forty-five seconds. The same alarm was given over a watch signal box of the Home Telegraph & Signal company in six seconds.

A Russell engine has superseded water power at the electric light plant at Kingman, Kas.

The United States Electric Light company have equipped the large establishment of Jacob Dold & Sons, packers, of this city, with their system. Kerite wire is used throughout.

The Kansas City Electric Light company, E. R. Weeks, general manager, have turned darkness into daylight. They operate three separate stations from which they furnish current for 800 arc lights, a great number of incandescent lights, and several motors.

Armour's packing establishment is being equipped with 600 incandescent lights, furnished by the Ft. Wayne Jenney company, under the supervision of I. Brinkner.

The latest electrical enterprise here is under the management of L. H. Holmes, who has placed in circuit over sixty electric time clocks, which have given great satisfaction. Mr. Holmes states that he cannot get clocks enough to fill the orders he has already received. He uses the Warner system. The switch board has a capacity of 500 clocks. The central station is located in Cady & Olmstead's large jewelry establishment. Signals are received once a day by direct wire from the observatory at Glasgow, Mo., giving absolutely correct time.

The Inter-state Electric company, of this city, under the management of Paul W. Bossart, have installed several plants recently and among the number one at Burton, Kas., which now has 150 lights in operation. Their intention is to increase the plant by 300 lights more at once. They use the Edison special accumulator lamp, 60 volt, .7 ampere, 16 candle power. The accumulators are charged during the day from an Edison machine, operated by an engine which is constantly in use during the day time. As a matter of economy this system gives great satisfaction. The same company has also furnished a plant of 75 lights to the Kansas City, Ft. Scott & Gulf Ry. Their exhibition plant at their office in the Nelson building, is operated by the United States system, which furnishes the light for the entire building.

The Electrical Supply Co., at Kansas City, represented by C. H. Cone, owing to their rapidly increased business, have been compelled to seek larger quarters. They are now at 125 West Sixth street, room 6. H.

THE ELECTRIC LIGHT.

Electric lighting is making rapid progress in Belgium, numerous private installations having recently been fitted up in Brussels, Liège and Ghent, and many others are in prospect. The lighting of the Brussels electrical exhibition especially is engaging the attention of various Belgian firms.

The electric light has been introduced into the Osaka bazaar in Japan, which has in consequence received a great increase of visitors.

Electricity is being extensively utilized in the collieries of Wales, both for power and light. At the National colliery at Wattstown 200 Edison-Swan incandescent lamps were introduced as an experiment, and the colliers give them their unqualified approval, for superior light, absence of smoke and necessity of attention; 2500 of these lamps are now in process of manufacture for the various other collieries owned by the company, and when these are ready for use not a single oil lamp will be allowed in any of the pits. Mr. Swan has also a new electric gas-detector, attachable to the miner's lamp, and capable of indicating fire damp in quantities much more minute than can be detected by any oil lamp.

Burlington, Kan., expects to have the electric light in operation by February 1st.

Concordia, Kan., has 61 arc lights of 2,000 candle power; 14 of these lights are on the streets and 47 in business houses. Fifty-four incandescent lights, all of which have been contracted for, are now being put in. The incandescent lamps cost $1.25 each per month.

Sterling, Kan., was lighted for the first time by the electric light December 17th.

North Topeka, Kan., wants the electric light.

D. L. Davis of Salem, O., has secured a five-year contract for lighting that city with 55 arc lights of 1,200 candle power each. The lights are to be in operation by April 1st, 1888.

Two 50-light Thomson-Houston dynamos have been ordered for Sheffield, Eng.

Almost all the trains running between Airdrie, Hamilton, and Hyndland station in Scotland have now been fitted with electric light, by means of an arrangement of a trailing conductor taking current from a central rail. The Glasgow and Helensburgh, Balloch and Milngavie services are also being provided with the appliance.

The common council of Rochester, N. Y., has appointed George Belknap, inspector of city electric and gas lights.

Guelph, in Canada, is to be lighted by means of 16 arc lamps, the cost of which is estimated at 43 cents per light per night.

Benhall lodge, Suffolk, the seat of Edmund Hollond, says the London *Electrical Review*, is now lighted throughout by the electric light. The dynamo is driven by an engine of the ordinary agricultural type of 8 horse power nominal, and is capable of easily working 100 16 candle power lamps. In addition to the dynamo there is also an accumulator capable of working 75 lamps of 16 candle power for 9 or 10 hours. The engine house is about 150 yards away from the mansion, and the wires are laid underground, securely protected by lead pipes. In the ordinary way the engine will be run for a few hours during the day-time, in order to charge the accumulator, at the same time doing other work, such as sawing wood and pumping water. The pumping will be effected by means of an electric motor, as the pump is at some distance from the engine. Ordinarily the accumulator alone will supply the lights, but on special occasions, when all the lights are wanted, the engines will be at work, during the evening also. There are altogether 157 lamps distributed throughout the house and stables. There are 39 in the three drawing-rooms, some placed near the ceiling—in the centre piece—some on the lustres and others in the form of hand-lamps.

Professor Dobroslawin, of St. Petersburg, in a recent paper on the comparative use of gas and electricity for lighting theaters refers to experiments made last February on the temperature and ventilation of the Grand and Alexander theaters, lighted with gas, and the Maria theater, lighted with electricity. These three theaters gave each two performances daily, and each held about 1,600 people. The thermometers were so placed as to be on a level with the audience. The carbonic acid was determined by the Pettenkofer method. As is well known, the temperature falls between the acts; and it was found that the temperature in the galleries did not fall as rapidly as in the pit. As a result, the professor thinks that people seated in the pit are more apt to take cold than those in the upper parts of the house. The highest degree of temperature with electric lighting was 25° C., and with gas 33° C. Professor Dobroslawin does not think that the difference of air is noticeable with either kind of lighting. Finally, he concludes that electricity is far superior to gas from the standpoint of health. Ralph Nevill recently read a paper on "The auditorium of a theater," before the Royal Society of British Architects, in the course of which he said lighting ought to be regarded by the manager as a potent means of inspiriting an audience. It might be accepted that the electric light would be used, but nevertheless provision must be made for gas. To be successful artistically the light must be various. In the event of fire the electric light would be extinguished; the gas sunlight ought therefore never to be put out, but turned low during the performance, and turned up full between the acts, the electric light being turned quite out in the first case, so that the eye may be entirely drawn to the stage. The front of the circles was the natural place for electric lights. The electric light rendered no great provision of fresh air necessary during a performance. It would, however, be always requisite to provide an exit for impure air; and as long as gas was used behind the scenes, there must be sufficient ventilation to take away the enormous and dangerous heat at the top, without creating a draught to the stage.

THE ELECTRIC MOTOR.

The directors of the Whitefish Bay Dummy railway line have decided to use electricity for a motor as soon as their track is laid, and sent a man to New York to make investigations into the merits of different appliances, reads a Milwaukee dispatch of the 21st.

The municipality of Geneva, has decided to combine a system of electric transmission with its extensive hydraulic system, to furnish power to workshops, such as those of clock and watchmakers, in the upper stories of buildings, as well as electric light for the theater, and thus utilize the water power of the Rhone electrically.

Since August 1st, says the *London Electrical Review*, the Elieson cars have run a total distance of over 20,000 miles in the most perfect and punctual manner. Statements of the number of passengers carried have been supplied by the North Metropolitan Tramways company, which conclusively prove that the public prefer this mode of conveyance to horse cars.

THE TELEPHONE.

Telephonic communication between Paris and Lille, a distance of 120 miles, was established December 1st, and is now open to the public at one franc for five minutes conversation through any of the public telephones.

The telephone between Paris and Brussels is proving very successful. The line is almost monopolized by newspapers, news agencies, and financial companies. A second line is to be completed soon; when it is expected that the income from private messages, which is already considerable, will be greatly augmented.

The executive committee of the People's Telephone association of Rochester, N. Y., met again on the 19th inst. A resolution was adopted that no proposition from the Bell company should be entertained that did not have in view the undergrounding of the wires of the company.

Telegraph and telephone wire, made of a special alloy intended to supersede silicium and phosphor bronze, is now being introduced by Rosthorn, a wire manufacturer of Oed, Austria.

Various suits for annulling the patent claims of the Bell Telephone company in Austria have been prosecuted during the past six years. An English exchange states that claims 13 and 15 were annulled as regards Austria-Hungary in March, 1885. Claims 1 to 10 were annulled in

Lower Austria in April, 1886. And the latest decision, Oct. 28, 1887, annuls ten of the most important claims, and practically destroys the whole value of the patent in Austria. These claims relate to the transmission of articulate sounds by induction, produced by the deformation of iron plates; the employment of resonators; the combination of a steel magnet with a prolongation of soft iron surrounded by a bobbin; the production of musical sounds by means of undulatory electric currents, the production of continuous undulatory current by the oscillations of a body capable of inductive action, or of a bobbin in the neighborhood of such a body. The ground of this last decision is that the invention was already known in Austria at the time the patent was granted.

October 31st the telephone subscribers in Italy were divided among the various cities as follows: Venice 268, Naples 992, Palermo 520, Catania 232, Messina 183, Milan 1,213, Turin, 681, Genoa 409, Florence 748, Bologna 375, Leghorn 388, Rome 1,835.

THE TELEGRAPH.

An English exchange states that just one hundred years ago Arthur Young, travelling through France, was introduced to M. Lomond, an ingenious mechanic, who showed him "an electrical machine connected with a wire and a similar electrical meter at a distance where his wife writes down the words indicated by the motions of a pith ball—the length of the wire makes no difference."

It is stated, on good authority, that the negotiations between the French and English governments for the joint working of the submarine cables across the English channel have progressed so far that no doubt whatever is now entertained that a satisfactory arrangement will be arrived at.

The English government firmly declines to grant a prolongation of the Submarine Telegraph company's license to land cables on British shores, and not to renew, after January 12th, 1889, the working agreement between the postmaster-general and the company.

An Annapolis, Md. dispatch of the 17th reads: In the Court of Appeals Judge Bryan has delivered the opinion of the court in the case of Postal Telegraph company vs. Samuel Snowden, George W. Dobbin, receivers, *et al.* On the former appeal in this case it was decided that the Postal Telegraph company, of Baltimore City, had no real or substantial interest in the telegraph wires, poles and other property which were the subject of controversy in the suit, and that all of it belonged to the Postal Telegraph and Cable company, and should be devoted to the payment of its debts, and to that end it should be sold by the receivers in the case. The Postal Telegraph company of New York, after this decision, decided to come in and be a party to the suit to press its claim on a note of $91,000 given by the Postal Telegraph and Cable company for the construction of its lines. A simple contract, credited at this stage, the court decides, had no right to interfere in the litigation concerning it. The order was affirmed and the cause remanded.

Miscellaneous Notes.

A Spanish shepherd killed by lightning recently was made the subject of a post mortem examination, to discover how the electric charge had done its fatal work. His eye-brows and eyelashes were burnt off, his eye-balls were dried up, all his left side was scorched and burned in spots down to the ankle, while the right side of the body and right leg were uninjured. Serious as these injuries were, none of them appeared sufficient to have caused his instant death. But as soon as the breast was opened, the cause of death was soon apparent. The lungs were frightfully congested, and the heart was enormously dilated and filled with coagulated blood. With all this damage to the man, his clothing was very little injured, the only trace of the lightning upon it being a small hole bored through the rim of the hat and a slight singeing of the shirt collar.—*Index.*

The Massachusetts railroad commissioners have issued a circular calling upon the railroads for information in regard to present methods of heating and lighting cars. The clause relating to the latter asks for "a description of such system or systems as you may have for lighting cars, stating the kind of lamps and oil used, the method of lighting by electricity, with an estimate of the relative cost of oil and electricity, if both are in use."

Last week a bill was introduced in the fiftieth congress "to protect innocent purchasers of patented articles, making it a valid defense against actions for infringement, that the article was bought for use or consumption, not for sale, and in good faith and in the usual course of trade; and providing that all patents shall be subject to purchase by the government for general use at a reasonable valuation."

One of the inventors of the electrical matrix-making machine designed to do the work of a compositor, mentioned in a recent number of this journal, thus describes some of the salient features of the apparatus: In the center of the machine is a type or die-plate which carries ninety-one dies comprising all the necessary characters. This die-plate stands on short legs and slides on a steel plate, which has a small hole in its center through which the dies are driven to the matrix below. The die-plate is attached to a thin lever, on the outer end of which is attached a hard rubber button like that on a telegrapher's "key." The letter is pivoted on a slide moving in and out from the center of the machine. By means of this swinging and sliding motion a person taking hold of the button on the lever may throw any part of the die-plate over the hole in the steel plate below. At the outer end of the lever, just below the button, is a metallic point which just slides over a hard rubber plate with holes arranged to correspond exactly with the arrangement of the dies in the die-plate. By bringing the button over and pressing it down into one of these holes, the corresponding die is brought directly over the hole in the steel plate. The act of pressing the key down makes an electrical connection which throws the matrix the proper distance for the letter to be printed, and at the same time throws down a hammer upon the die, driving it through the hole into the matrix. The operator's attention is confined strictly to pressing the key into the proper holes and to throwing the spaces. When the end of a line is reached a touch upon a key returns the matrix to the beginning of the line, when a touch upon a third key moves the matrix for either an ordinry or a leaded line, as desired.

To electricity all things are possible. Witness this incident: Lightning struck a basket of eggs in a farm yard near Meridian, Miss., not long ago, and a man who witnessed the descent of the electric current solemnly declared that it hatched out chickens from several of the eggs.

The Electrical Protective Supply company of Chicago has been incorporated. The capital stock is $100,000 and the incorporators are F. S. Terry, H. S. Smiley and F. W. Parker.

At Marion, Indiana, on the 19th, inst., a team of horses owned by D. P. McKinney was killed under peculiar circumstances. One of the natural-gas arches was accidentally torn down and the electric light wire which was attached dropped to the street. McKinney's team following a few minutes later stepped on the charged wire and both horses fell dead from the shock.

The California and Oregon railway was completed at Ashland, Oregon, on the 17th, and the programme of announcing the event along the Pacific coast by firing guns and ringing bells, through the medium of an electrical circuit in connection with the last spike driven, was carried out.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	390
Central Union	44	45
Michigan	76	77
Great Southern	30	32
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	28	30
Missouri and Kansas	68	69

Business Mention.

Howard Fairbrother, representing the Ireson link belt, has received orders from the Chicago Arc Light & Power Co., from the Western Electric Co. and from J. H. Reid of the Mather Electric Co. The outlook for business is so promising that Mr. Fairbrother will stay in the west until March next.

The Central Electric Co., 38 and 40 La Salle street, Chicago, have taken the exclusive agency for the states of Illinois, Michigan, and Indiana for the McCulloh American district telegraph system, and are prepared to grant licenses and furnish material for complete outfits.

The Callender Insulating & Waterproofing Co. of New York have appointed the Electric Improvement Co., 217 Sansome street, San Francisco, Cal., agents for the sale of their bitite insulated house wires and cables and also agents for their trinidad wires for the states of California, Nevada and Oregon and for Arizona and Washington territories. The manufacturing company have been shipping a considerable quantity of wire to California for some time.

The Silvey Electric company, recently established at Lima, O., have received and put in place part of the machinery for their works, and their building is being fitted up to receive the remainder of their order, which they are notified has been shipped. They expect to have their plant in shape to begin operations by January 1st. Their office in the Globe Machine works building is a model of neatness and taste, and in keeping with the vigor and push manifested by the management.

Electrical Patents.

Issued Dec. 20, 1887.

374,948. Clip or hanger clasp for supporting cables, etc. Thomas T. Eckert, New York, N. Y.

The cable hanger consists of a single strap of sheet metal. One end passes over the supporting wire and down so as to lap over the other end of the strap. The lapped ends are not bolted or otherwise fastened together.

374,959. Dynamo Electric Machine. Joshua Gray, Medford, Mass.

The second claim is as follows: "In a dynamo electric machine, the combination of an exterior and interior field magnet pole with a series of armatures rotating in the same direction within the magnetic field and in inductive proximity to each other, substantially as described.

375,001. Electro-pneumatic Mechanical Movement. Alfred Roosevelt, New York, N. Y., executor of Hilborne L. Roosevelt, deceased.

375,007. Galvanic Battery. James Serson, Boston, Mass.

375,014. Cut-out for Electrical Distribution Apparatus. Marmaduke M. M. Slattery, Woburn, Mass.

375,022. Method of Electric Welding. Elihu Thomson, Lynn, Mass.

The abutting ends of the pieces to be welded are preferably made tapering. These ends are forced together with a moderate pressure and then after the parts are raised to a welding heat by the electric current, the pressure is increased to form the weld.

375,034. Carbon Electrode for Galvanic Batteries. Chas. H. Wilder, Natick, Mass.

The element consists of particles of ground coke united by coal-tar and bitumen, the whole being heated to a high temperature to render the formed carbon homogeneous.

375,063. Railway Signal. J. Harper Gibson, New York, N. Y.

375,083. Signal Box. Morris Martin, Malden, Mass.

375,117. Combined Gas and Electric Light Fixture. Sigmund Bergmann, New York, N. Y.

375,118. Electric Gas-Lighting Apparatus. Charles B. Bosworth, Everett, Mass.

375,160. Railway Train Timer. George W. Housel, Bloomsbury, N. J.

375,238. Electrical Circuit Closer. Marshall M. Welch, Atlanta, Ga.

375,242 (1) 375,243 (2) Thermo-Electric Generator. Edward G. Acheson, Pittsburg, Pa.

(1) Heat is caused to pass through one or more films of gas included in an electric circuit. There are nine claims.

(2) Contains five claims the first being: "The method of producing a difference of electrical potential between two solid conductors, which consists in heating one of them directly, and conveying the heat from the same to the other by a moving fluid conductor substantially as described."

375,255. Combined Electric Motor and Fan. Harry H. Blades, Detroit, Mich.

375,276. Insulator. Edward C. Emery, San Diego, Cal.

375,280. Tip for telephone cords. Frederick A. Forbes, Detroit, Mich.

375,295. Insulated electrical conductor. Alfred Kissel, Salem, Mass.

The conductor is carried by a substance called Adamanta rubber, which is composed of resin, caustic alkaline earth, oil and sulphur.

375,299. Municipal telegraph. Morris Martin, Malden, Mass.

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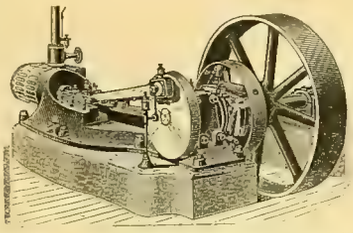

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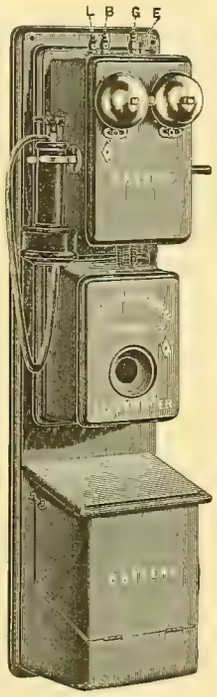

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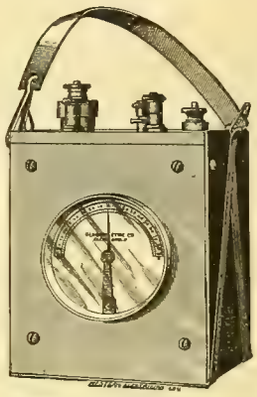

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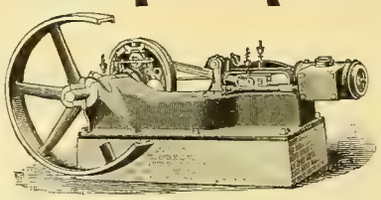

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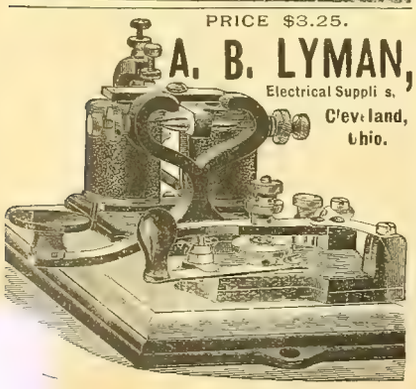

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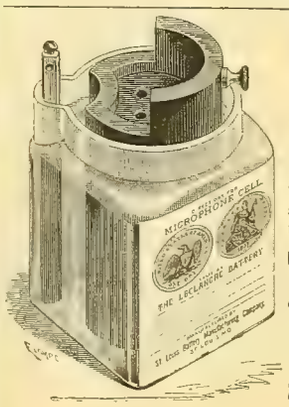

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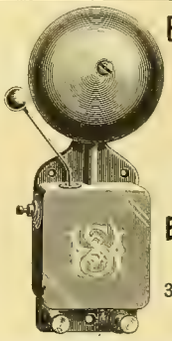

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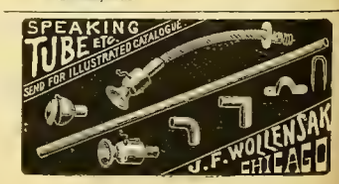

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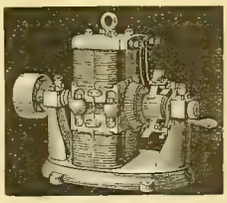

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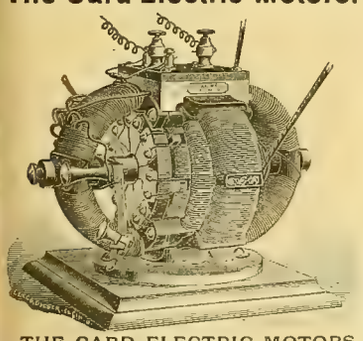

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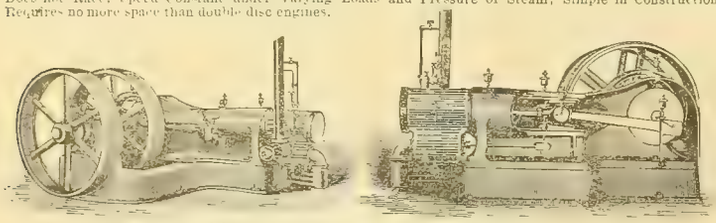

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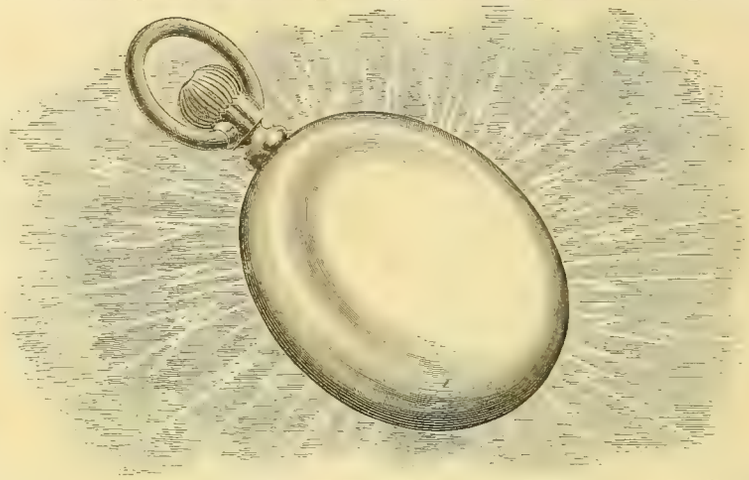

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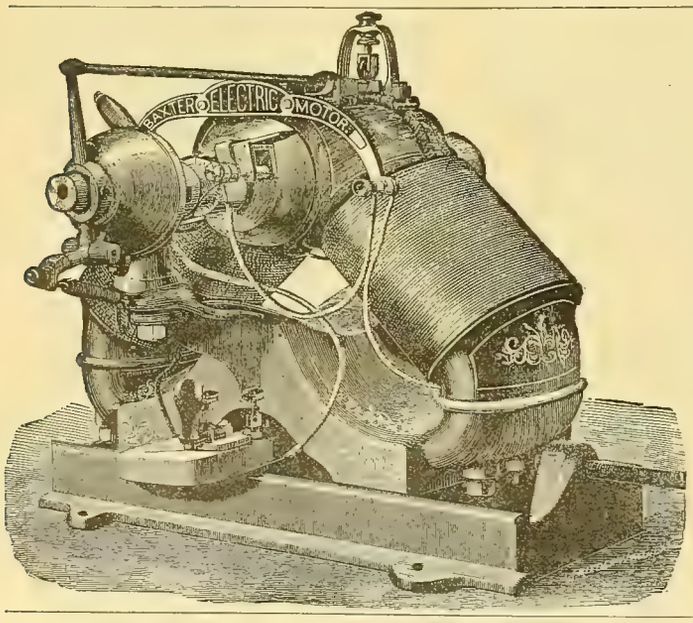

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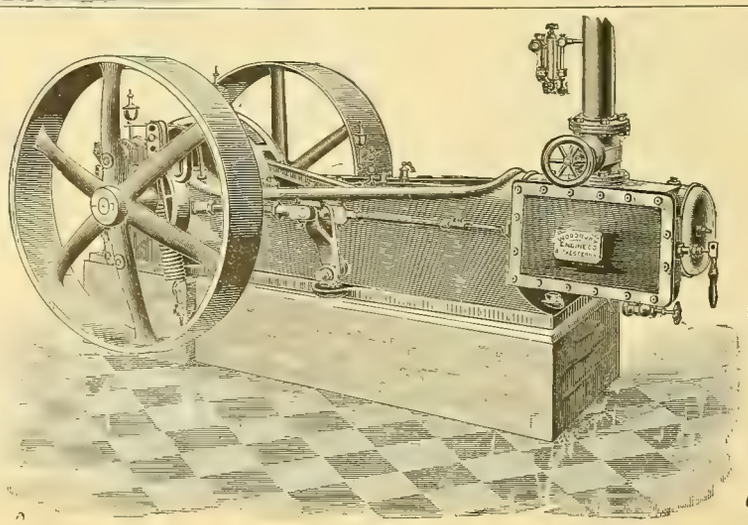

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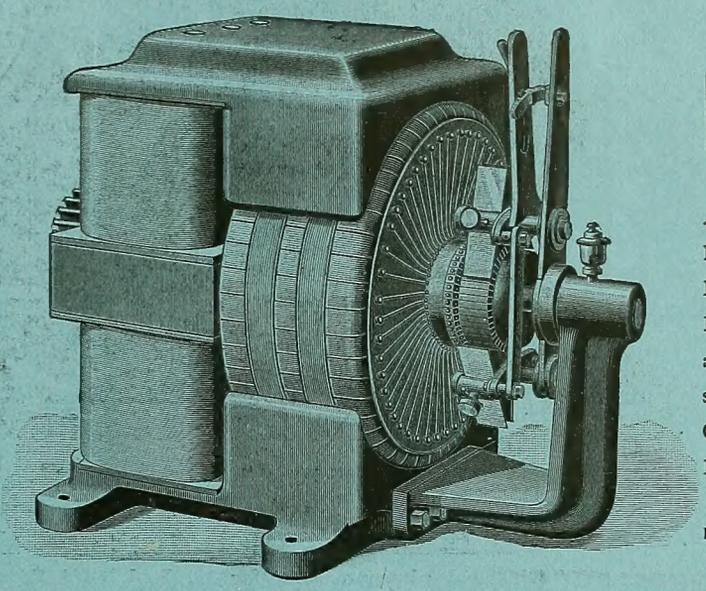

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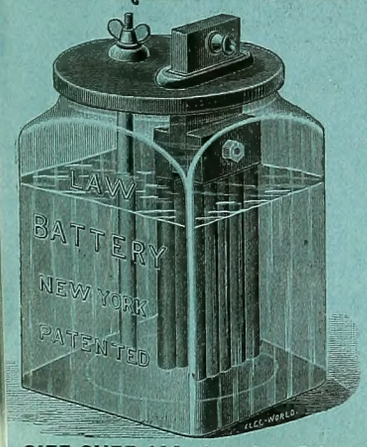

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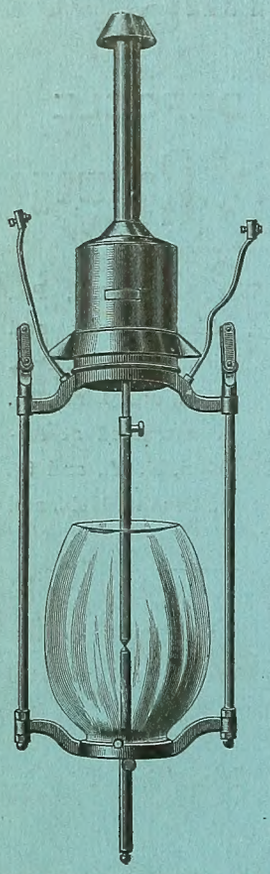

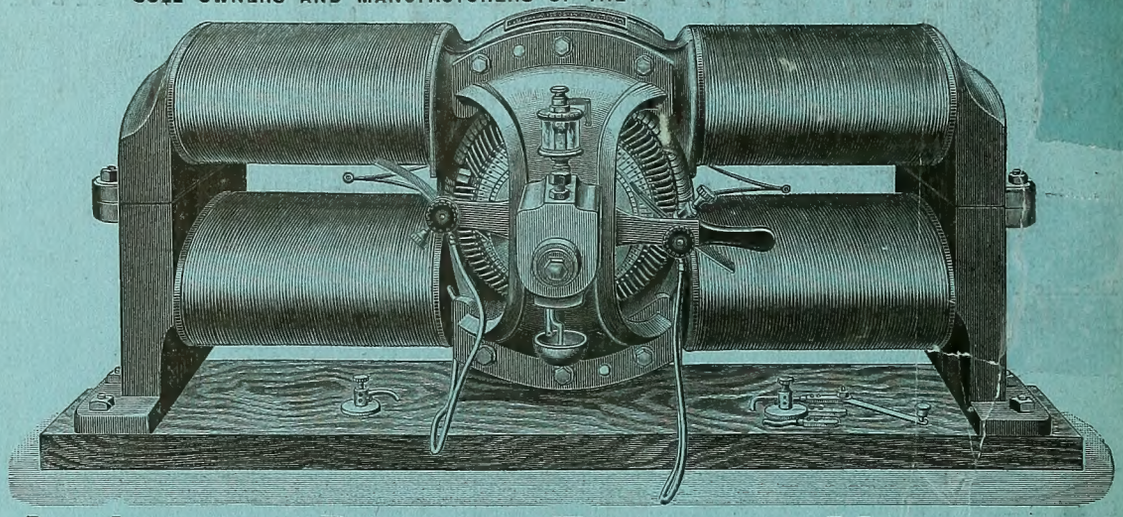

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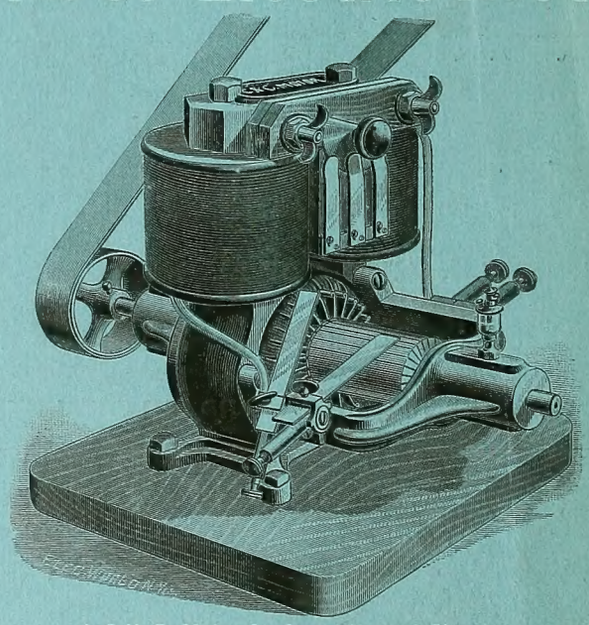

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